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Rubber Age

COVERING THE MANUFACTURE OF RUBBER AND RUBBERLIKE PLASTICS PRODUCTS

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Highlights Sidelights *of the News . . .*

January, 1959

The Rubber Manufacturers Association estimates that 1.5 million long tons of new rubber will be consumed in the United States in 1959 . . . Speaking of world capacity, RMA estimates that by 1962 the Free World will have the ability to produce 4.3 million long tons of new rubber a year . . . a 27 per cent increase in five years (page 648).

The Rubber and Plastics Division of the American Society of Mechanical Engineers held a two-day meeting on December 3 and 4 in New York City which included three technical sessions, each of which was attended by some 90 members and guests . . . The first technical session included a number of interesting papers devoted to the subject of adhesives (page 650).

Industry figures in the news this month include P. W. Litchfield, retired chairman of the board of the Goodyear Tire & Rubber Co., who was honored at a testimonial dinner in Akron on December 15 . . . More than 800 industrial and civic leaders were in attendance (page 653) . . . Also honored, Dr. Isaac Drogin, vice-president of the United Carbon Co., who has been elected a Fellow of the Institution of the Rubber Industry (page 649).

Over 940 persons participated in the Seventh Annual Wire and Cable Symposium held on December 2, 3 and 4 at the Berkeley-Carteret Hotel in Asbury Park, N. J. . . . Sponsored by the U.S. Army Signal Research and Development Laboratory, the theme of the meeting was "Technical Progress in Communication Wire and Cable" (page 652).

A tentative program has been scheduled for the International Rubber Conference which will be held from November 8 to 13 in Washington, D. C. . . . Titles for papers on various aspects of rubber technology have been submitted by scientists throughout the world (page 656).

Be Sure Not To Miss

Our annual Review and Preview of the Rubber Industry which begins on page 597 of this issue . . . Containing our appraisal of rubber industry activities in 1958 . . . It also attempts a survey of conditions as they may be expected to develop in 1959 . . . The Review and Preview also contains exclusive statements from many industry leaders. Also read "As Soule Sees It" a new monthly feature prepared especially for the readers of RUBBER AGE by Kenneth Soule, formerly of Raybestos-Manhattan (page 589).

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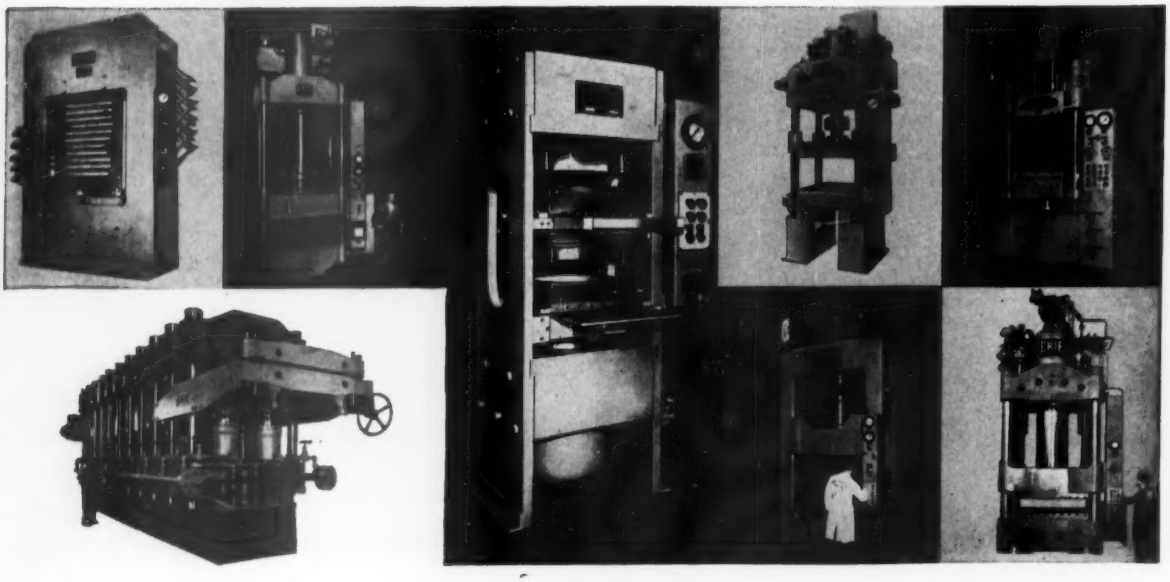

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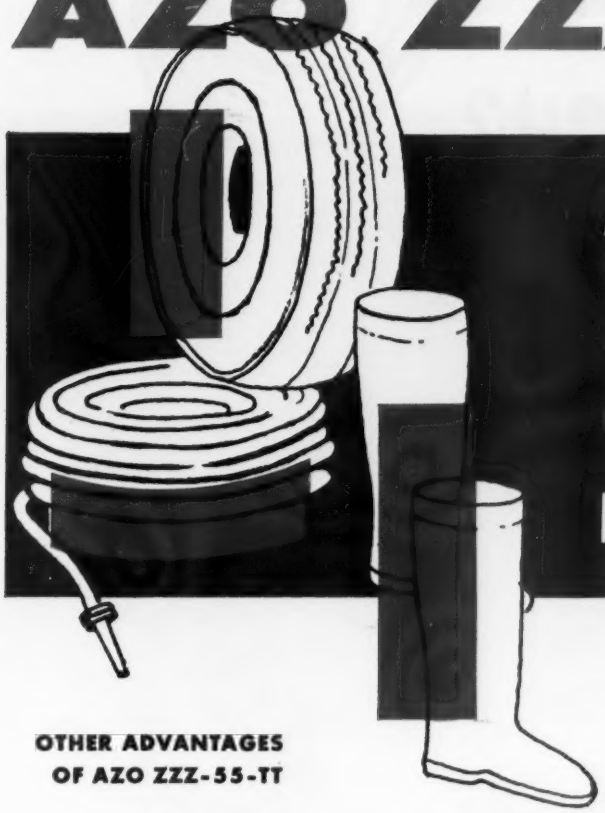

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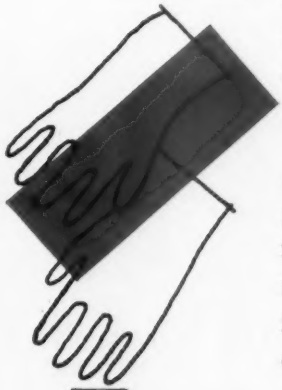

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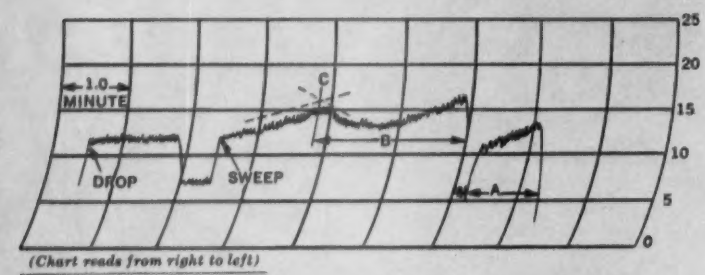

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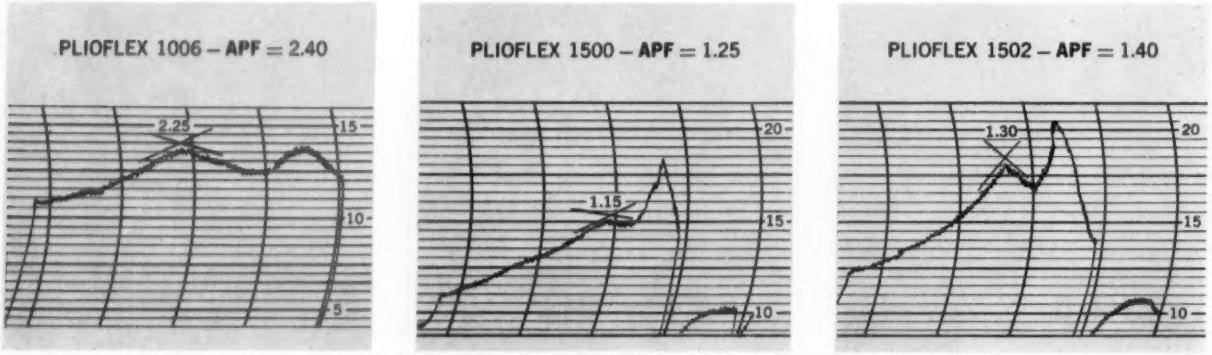
And here are the Assured Processability



NOTE: Shown above are typical Banbury power consumption charts for various PLIOFLEX rubbers. From these charts, maximum pigment incorporation times are determined and Assured Processability Factors established.

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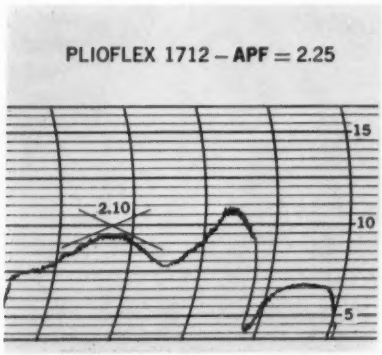

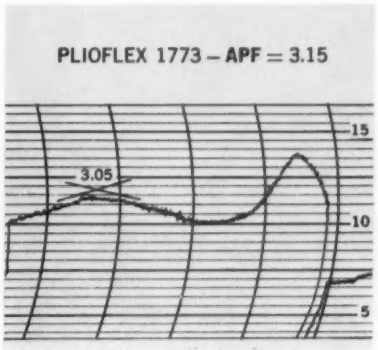

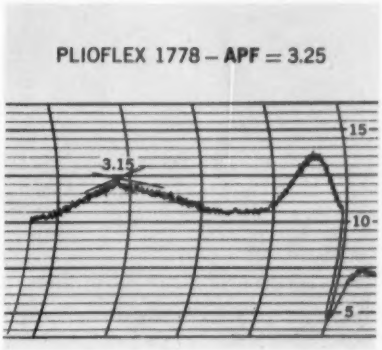

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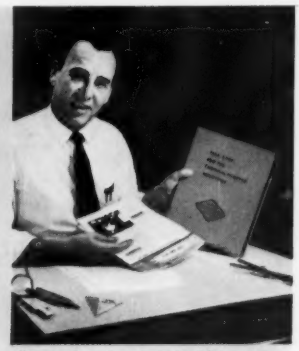

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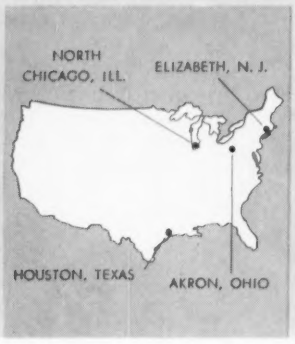

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• Representatives of the French rubber and plastics industries and a group of French mill suppliers visited Germany, Denmark and Italy recently to study latest industrial developments and progress. In view of the formation of the European common market, the group tried to establish and improve contacts with the respective industries and trade circles.

In Germany, they visited a number of outstanding factories, such as Farbwerke Hoechst in Frankfort/Main, Continental Rubber Co. and Herm. Mueller & Co., in Hannover. Prices, wages, social benefits, manufacturing programs and methods of production were discussed at various roundtable conferences.

The French trade group was interested in buying articles made of rubber or plastics, while the industrial group explored the possibility of buying German machinery and raw materials.

• The Society of German Standards (Deutscher Normenausschuss) has organized a special department to publish translations of German industrial standards. Expected to facilitate German exports and later to help establish world standards, the 1045 translations are now available in English, French and Spanish. Lists, in English, French and Spanish, which contain order numbers, publication dates and descriptions of the standards, may be obtained free of charge from Beuth Vertriebs GmbH., Berlin W. 15, Germany.

• The Montecatini factory in Ferrara, Italy, which manufactures polypropylene under the trade name of "Moplen", plans to increase its capacity from 6800 to 20,000 tons annually. An improved manufacturing process will also be used.

Societa Cabot Italiana plans to build a carbon black factory during 1959, which will have a capacity of 14,000 tons a year.

• In South Africa, Dunlop South Africa, Ltd., has paid a dividend of 15 per cent to its shareholders and Goodyear Tire, Ltd., has also declared a dividend of 15 per cent. Another firm in South Africa, General Tire & Rubber Co., Ltd., has increased the capacity at its factory in Port Elizabeth.

• The Italian chemical concern, Rumianca, Ltd., and the U. S. Rubber Co. have formed a new company, Naugatuck-Rumianca S. p. A., to handle the production and sale of a number of chemical products developed by the Naugatuck Chemical Division of the U. S. Rubber Co.

A new factory will be constructed in Borgaro-Torinese near Turin, Italy, which will manufacture a number of chemicals essential to the rubber industry, such as accelerators, regenerators, vulcanizing agents, rubber-latex and styrene resins. U. S. Rubber will act as a consultant, plan the lay-out and equipment for the new factory, and will later supervise the manufacturing process. The Italian technical staff will be trained at the Naugatuck, Conn., plant.

• Waste Rubber Merchants Association of Great Britain, in London, and the German Association of Waste Rubber Dealers, in Hannover, have formed an International Association in order to promote and facilitate waste rubber trade on the European market. R. H. Birks, one of the officers of the British association, has been named president and H. Bolte, president of the German association, has been elected a vice-president. The secretary of the British association will act as secretary of the federation.

• A new concern, Danubia Petrochemie A. G., having a capital of 90 million Austrian Schillings (about $3½ million), has been formed at Linz, Austria, by the Italian Montecatini Co. and Austrian Stickstoffwerke. Each firm supplied 40 per cent of the capital, while the balance was provided by private sources. The new company will manufacture polypropylene, known in Italy as "Moplen", which will be merchandised in Austria as "Daplen". The factory will be constructed in Schwechat, a suburb of Vienna, not far from the site of the planned largest crude oil refinery in Austria. Austrian production of Polypropylene is expected to reach 5000 tons annually by 1961.

• Michelin and Bergougnan, two leading French tire factories, have recently signed a contract to exchange technical information in order to take better advantage of the European market. Other companies may join the cooperative movement without giving up their autonomy.

• Firestone Tire & Rubber Co. will build a tire factory at Sebutal, near Lisbon, Portugal, which will be ready to start production in about a year.

• Czechoslovakia is building a very large factory for synthetic rubber production at Kralupy nad Vltavon, in the vicinity of Prague, which will supply half of the requirements of that country.

Last month, in "On the Continent", it was stated that "synthetic rubber capacity in West Germany will reach 3.1 million tons by 1960." Of course, what was meant was that world capacity should reach 3.1 million tons by 1960. We regret the error!

On the Continent

• Official statistics issued by the Ministry of Foreign Trade in Russia, indicate that imports of natural rubber have risen from 35,300 tons in 1955, to 140,700 tons in 1958. Synthetic rubber imports rose from 25,500 tons in 1955, to 26,100 tons in 1956.

• A tire factory is under construction in Pirot, Province of Serbia, Yugoslavia, for the production of automobile and bicycle tires. When completed the factory is expected to turn out 260,000 tires a year.

• During a recent meeting of the European chemical industries, developments taking place in the past few years were reviewed and the future outlook to 1961 was discussed. From 1945 to the end of 1957, approximately $140 million was invested in new buildings and machinery. It is believed that future investments will be made more rapidly and will reach about $1.2 billion by the end of 1960.

Larger facilities and increased production capacities have increased European output at a tremendous scale. In 1956, 470,000 tons of petrochemical raw materials were produced and in 1957, the output was increased to 630,000 tons. Production reached approximately 830,000 tons by the end of last year. Planned investments in new facilities and machinery should lift European production to more than 2 million tons by the end of 1960. Expanded production is planned for various types of synthetic rubber, derivatives of polyethylene and oxides of ethylene, solvents and raw material for plastics and other materials.

• Phillips Petroleum Co. and the Continental Carbon Co. have announced plans to build a carbon black plant in France with an initial capacity of 28,000 tons a year. The two companies will form an equally owned French company to build and operate the plant. Continental Carbon is owned by the Continental Oil Co., Shamrock Oil and Gas Corp. and Witco Chemical Co.

• Pierre Karmitz, of Paris, France, has discovered that some nickel organic compounds efficiently protect rubber against atmospheric agents. A new family of compounds, nickel xanthates, seem to be far more effective than dithiocarbamates and apparently do not have certain drawbacks of the latter. A study of 36 derivatives indicated that nickel isopropyl xanthate was most effective. The study covered different light and black vulcanizates, variously compounded and submitted to atmospheric agents, both with and without stress.

Differences have often been stressed between mass-degradations of vulcanizates and surface deteriorations, which begin with changes in color and formation of orientated or network cracks. Such degradations occur as a consequence of exposing vulcanizates to sun-rays, ozone or peroxides. By protecting rubber both against network and orientated cracks, nickel organic derivatives act more universally than most available anti-aging products. Their action may be fostered by adding di-phenyl-p. phenylene-diamine (DPPD) and in certain cases, a migration agent such as Heliozone.

Finally, a study of the absorption spectra of these organic nickel compounds suggests that the protection exercised by some of these compounds against the formation of orientated cracks might, at least in part, be attributed to the absorption of some particularly noxious rays.

• Soviet Russia has announced that production of synthetic rubber will amount to about one million tons in 1960. Russia expects to produce about 760,000 tons. East Germany should manufacture 100,000 tons and Poland and Rumania, each, plan to produce 50,000 tons annually.

• According to Russian sources, polymerization of cis-isoprene can be effected when cis-isoprene is dissolved in benzol to form a 20 to 25 per cent solution. A combination of tri-ethylene-aluminum and titanium tetra chloride (Ziegler catalyst) is used as a polymerization catalyst. About 0.3 to 0.6 per cent of the weight of the monomers is required. Polymerization starts at room temperature. During the process, which takes about 5 to 6 hours, the temperature is increased to 104 to 140°F. Alcohol is used to wash the precipitation and the rubber-latex is dried on rotary driers.

Aldol-α-Naphthylamine is an appropriate antioxidant and anti-aging agent, while phenol-β-naphthylamine acts as the least satisfactory additive. Natural synthetic rubber can be processed with the usual machinery and its behavior hardly differs from natural rubber, it is claimed.

Best results have been achieved with the use of 100 parts of polymers; 2 parts of stearic acid; 3 parts of diphenyl guanidine; 0.6 parts of dibenzothiacyldisulfide; 5 parts of zinc-oxide; and 1 part of sulfur. The optimal temperature for vulcanization is 273.2°F.

• A comparative study of continuous and discontinuous relaxations of diversely accelerated vulcanizates, suggests that the main factor in the development of stickiness is the initial network structure. When stickiness appears, a considerable relaxation of the network is noted. This is indicated by increased swelling and a markedly lower modulus.

Stickiness is apparently caused by breaks occurring not only across double-links along the chain, but also across inter-molecular cross-links, the latter being endowed with a varying chemical strength, depending on the accelerating system which is used. It is believed that the development of stickiness may be inhibited by combining the action of antioxidants and of a deachivator.

• Union Carbide Corp. has announced plans to create a new company jointly with the Societe Chimique des Derives du Petrole S. A., Petrochim, of Belgium. The concern will build a polyethylene plant near Antwerp, which will have an annual capacity of 30 million pounds. The new company will be called Cobenam and technical know-how for the plant will be provided by Union Carbide.

Scheduled to be completed in mid-1960, the Cobenam operation will use ethylene from the refinery of Societe Industrial Belge des Petroles. It has been estimated that cost of such a plant will be about $15 million. Petrochim is an affiliate of the giant Belgian financial and industrial combine, Societe Generale.

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or plastics are used...
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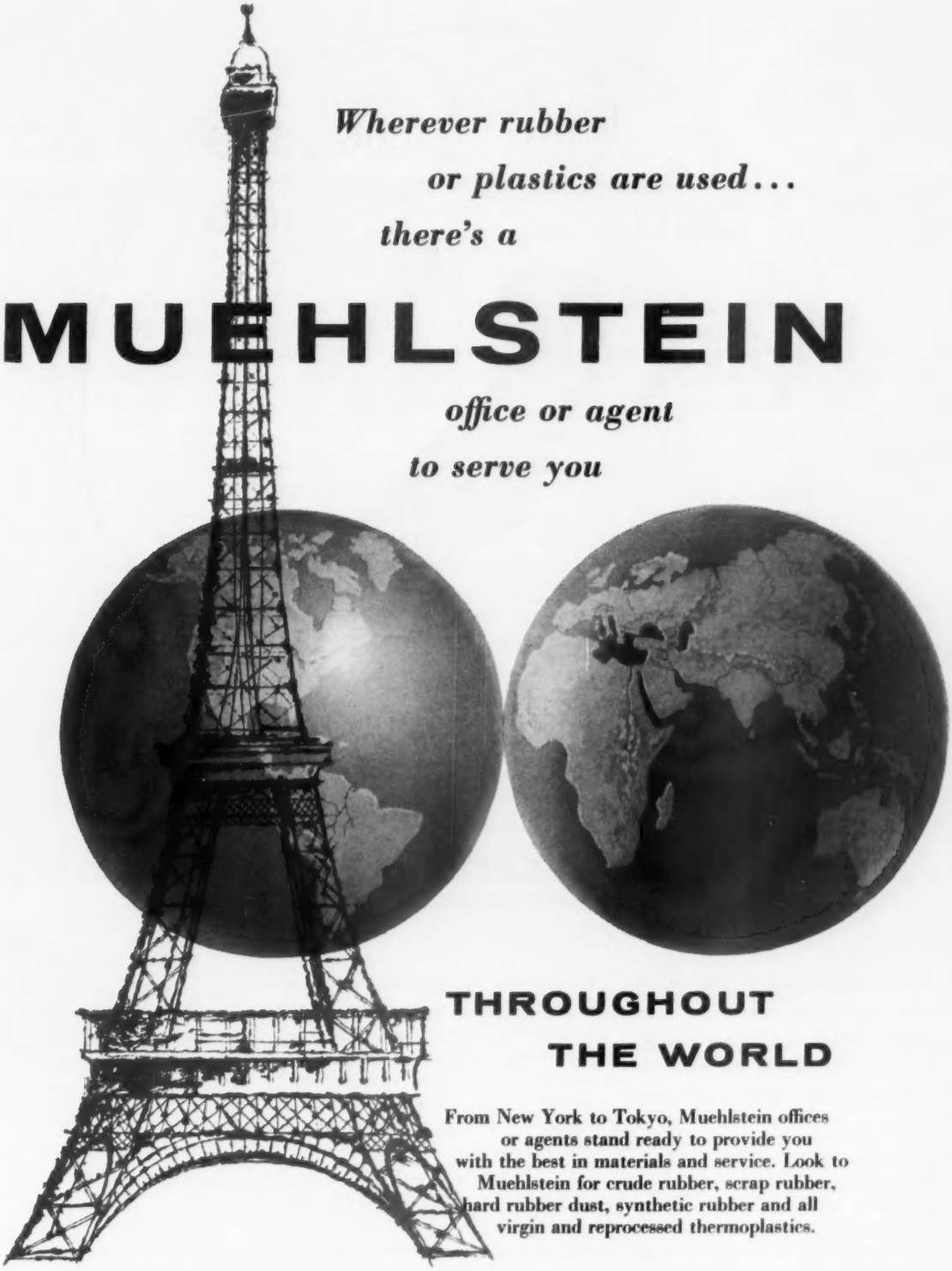

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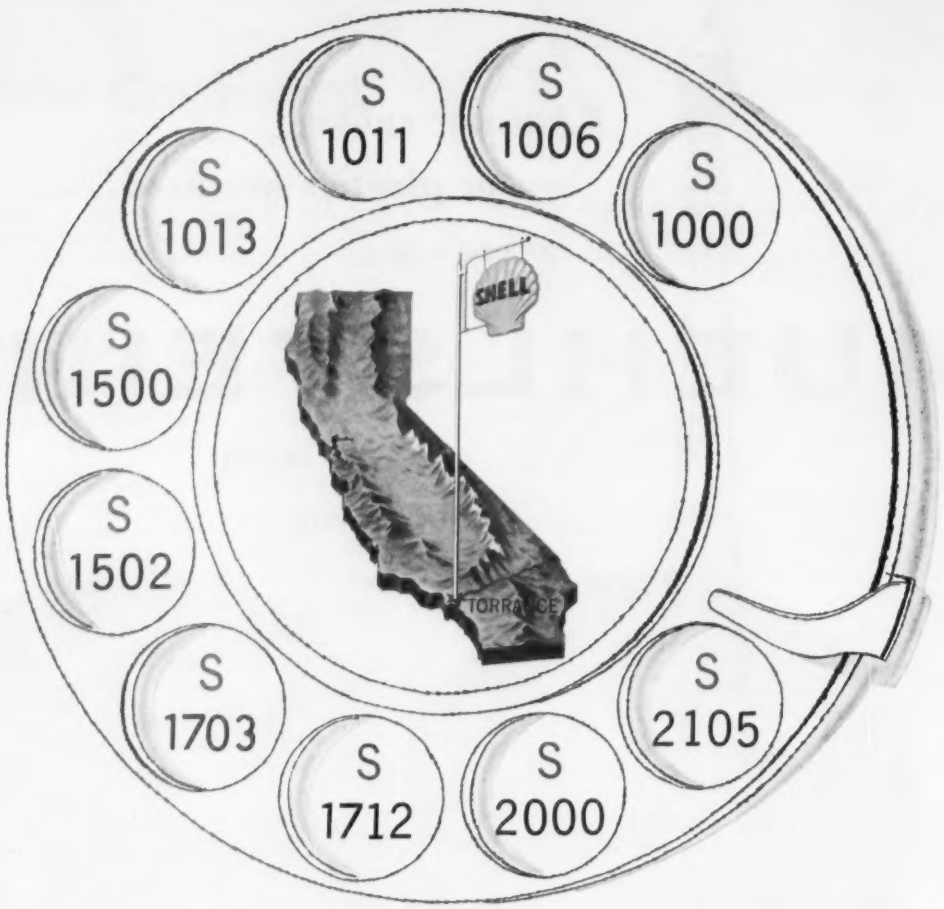

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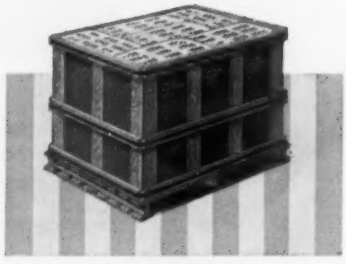

† Shell offers you the Flotainer* package, a strong, lightweight, steel-strapped wooden container that holds 42 film-wrapped bales. The "Flotainer" controls cold flow in uncured synthetic rubber; prevents contamination; simplifies and speeds handling; lets you store 20 tons of rubber on less than 100 sq. ft. of floor space. Write for an illustrated bulletin on this packaging innovation.

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Capitol Cues

THE BUSINESS OUTLOOK FOR 1959 has now taken fairly firm shape in the thinking of economists in government and industry. In a nutshell, experts see 1959 as one of the best years ever, with the current recovery rolling on to new highs, month after month. Sales and output will set new records, and rising productivity will lift profits sharply. Consumers will share in the benefits, too. Incomes will rise smartly while living costs remain stable.

THERE IS STILL SOME DOUBT ABOUT THE DEGREE OF BOOM that is coming. The expansion will be rapid—almost explosive—in the first six months of 1959, but there may be some slowdown in the growth rate in the second half. Much depends on what happens in autos, housing, and outlays for new plant. But businessmen can count on the government to keep the climate favorable. Credit won't be tightened enough to curb the recovery—except, perhaps, in the case of housing. And, despite the deficit, taxes won't be increased.

Here is what you can expect to see in three important areas:

- Governments at all levels plan to increase outlays by about $8 billion—and maybe more. Local governments will expend $3 billion more for schools, waterworks, etc. The U.S. will hike outlays $5 billion for defense, highways, and farm aid.
- Consumers will be buying $15 to $20 billion more, encouraged by rising incomes. Hard-good sales will increase 15%, autos setting the pace. Food, apparel, and services will rise, too.
- Business itself will spend much more on plant and equipment. And industry will start building inventory at a rapid clip.

THE ECONOMY WILL GROW A THUMPING 8% IN 1959, measuring in terms of Gross National Product—total output of goods and services. This will lift GNP to $475 billion for the year. This compares with the $440 billion total of 1958. The last quarter of '59 may see a still higher rate—$485 billion.

Other key business indicators will look like this in 1959:

- Industrial output will be up 8%, to 145% of the 1947-49 rate.
- Number employed will gain about 1.5 million, with those big jumps in factory output coming from rising productivity.
- Unemployment will go down about 1.2 million on the average. Labor force growth, plus productivity, explain the slowness.
- Housing starts will rise to 1.2 million, 5% to 6% over 1958.

PRICES WILL INCREASE ONLY MODERATELY, on the average, during 1959. The official Consumer Price Index will increase by 1% or even less. Services—rents, utilities, etc.—will be higher, as will manufactured goods such as appliances, autos, building materials, etc. But food will fall a bit in early 1959. Wholesale prices will rise 2%, with industrial items setting the pace.

(Continued on Next Page)

THE COST OF LABOR WILL RISE FASTER IN 1959 than in the year now ending. Manufacturing industries will see costs go up 9¢ to 10¢ an hour. This year, wage increases averaged 1¢ less; the business recession held boosts down. In nonmanufacturing hikes will run 11¢ an hour in 1959, as against 10¢ this year.

Increases in straight hourly wages will account for about 8¢ of the 1959 increase as against 6½¢ this year; unions want to make up for ground lost in the slump. Escalator clauses will bring the other 2¢. Fringe benefits will play a minor role. Unions will try mainly to bolster their existing benefits.

PROFITS ARE CERTAIN TO BE TERRIFIC NEXT YEAR. With industry's output expanding, productivity will go up faster than costs. The net before taxes may go as high as $48 billion, as compared with this year's $37 billion. The best year on record, so far, was 1956, when the total reached $45.5 billion.

CREDIT SEEMS LIKELY TO TIGHTEN STILL FURTHER, as was noted above. Money will be harder to find and interest rates will rise some more. Demand for credit will expand as industry starts to build inventory and to increase plant outlays. The government also will need more cash to pay its deficits.

The supply of money will increase some as corporate profits and savings rise. But it won't meet all demand. Monetary officials will keep the reins taut to curb inflation. Mortgage borrowers will feel the pinch the most; consumer credit will be plentiful.

ANOTHER RECORD CONSTRUCTION YEAR is in sight for 1959. Dollar outlays will go up about 7%, to $52 billion. Price increases for labor and materials will account for 2% or 3% of the boost. Tight money will hinder housing some.

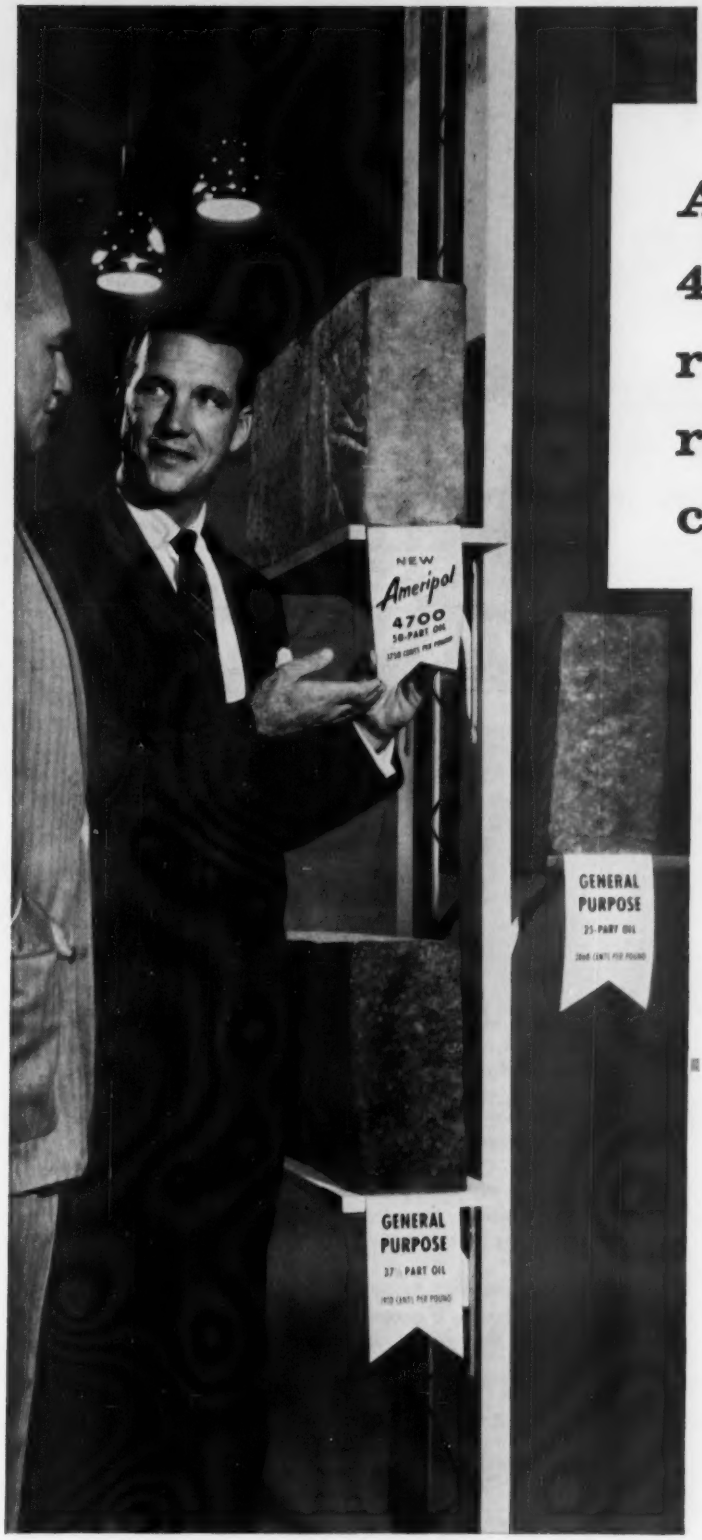
- Public outlays will jump 14%, more than twice the rise this year. Experts think public housing will rise 36%; highways, 12%; schools, 4%. Post offices and hospitals will gain, too.
- Private spending will be up 3% next year, as against a dip of 1% this year. Home-building will rise a little more, as will commercial work. Industrial and utility building will fall.

Next year will see pick-ups for building materials producers. Cement sales will rise 5% or 6%, those of clay products will be up 3%, while volume in paints and lumber will gain 4%-6%.

THE 1959 PICTURE FOR MACHINERY IS SPOTTY, some types slated to do much better than others. Increases in spending for plant and equipment, plus the rising trend to automation, will help certain lines. Prices will rise 2-10%.

Here's the outlook, line by line, as the experts see it:

- Machine tools—Sales, off over 60% in 1958, should pick up 15% to 20% next year, on ordering from auto and appliance makers.
- Construction—Sales will climb 10%, to $1.8 billion. (In '58, volume matched 1957's.) Rising road-building is a key factor.
- Office—With modernization expanding, sales will rise 10-12%.
- Other types—There will be nice gains for oilfield, railroad, and materials-handling-equipment, and textile machinery. But, some decreases are being forecast for 1959 for mining types.



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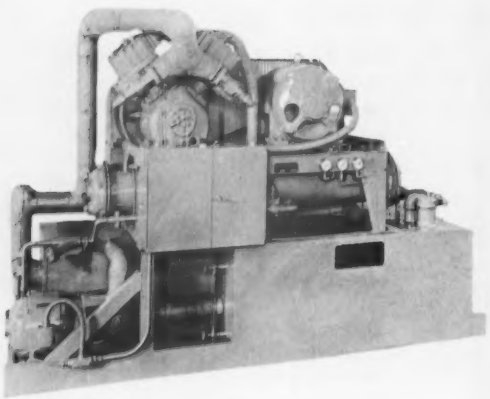

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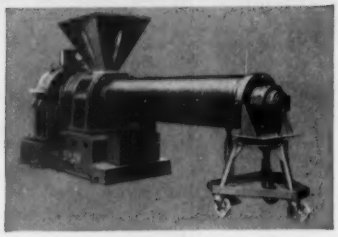

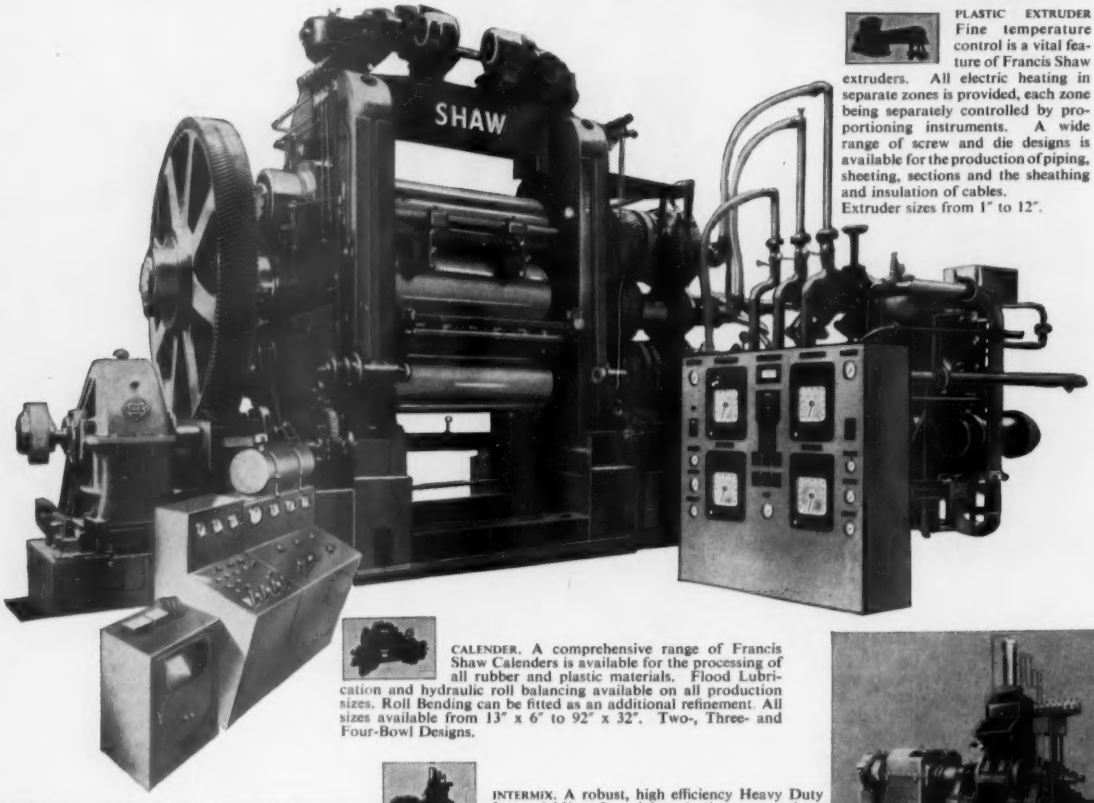

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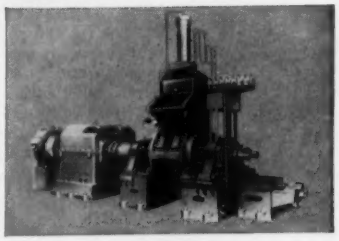

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News in Brief

► Pegasus International Corp., New York, N. Y., has published an informative booklet entitled "Foreign Licensing —Questions and Answers" which presents the advantages and disadvantages of licensing.

► Lord Manufacturing Co., Erie, Pa., has issued "Bulletin No. 601," which contains information on the new patented, low cost, bonded rubber "Meter Mounting" for protecting sensitive instruments against shock and vibration, and "Bulletin No. 709" which describes a compact, bonded rubber "Traction Motor Nose Support."

► Century Electric Co., St. Louis, Mo., has issued a new 12-page 1958 motor "Application Guide" which gives full details on the complete line of polyphase, single phase and direct current motors, 1/20 to 400 h.p.

► Instrument Society of America, Pittsburgh, Penna., has released a new color-sound film to instruct designers, manufacturers, users and students of control equipment in the principles and techniques of frequency response analysis.

► J. O. Ross Engineering Division of Midland-Ross Corp., New York, N. Y., has issued "Bulletin 61," which covers the Ross Constant Temperature and Humidity Control Unit for testing laboratories.

► A 42-page "Highway Truck Tire Data Book," published by B. F. Goodrich Tire Co., Akron, Ohio, lists and describes the main factors determining the degree of service that will be received from truck tires, suggets safety rules to follow when servicing truck tires, and carries table on load and inflation and weights and measures.

► A new electric fork truck preventative maintenance chart that lists time and money saving maintenance practices is now available from Lewis-Shepard Products, Inc., Watertown, Mass.

► J. H. Day Co., Division of the Cleveland Automatic Machine Co., Cincinnati, Ohio, has issued "Bulletin 158" which describes Day Three-Roll Dispersion Mills used for all types of paste or flowing materials.

► The Coatings Department of the Chemical Division of the Goodyear Tire and Rubber Co., Akron, Ohio, has presented a study of traffic paints, latex paints, aluminum paints and solvents in its "Tech Book Facts" series. Included are TBF 57-300 on "Pliolite VT"; TBF 57-298 on "Pliolite Latex 165"; TBF 57-299 and TBF 57-21 on "Pliolite S-5."

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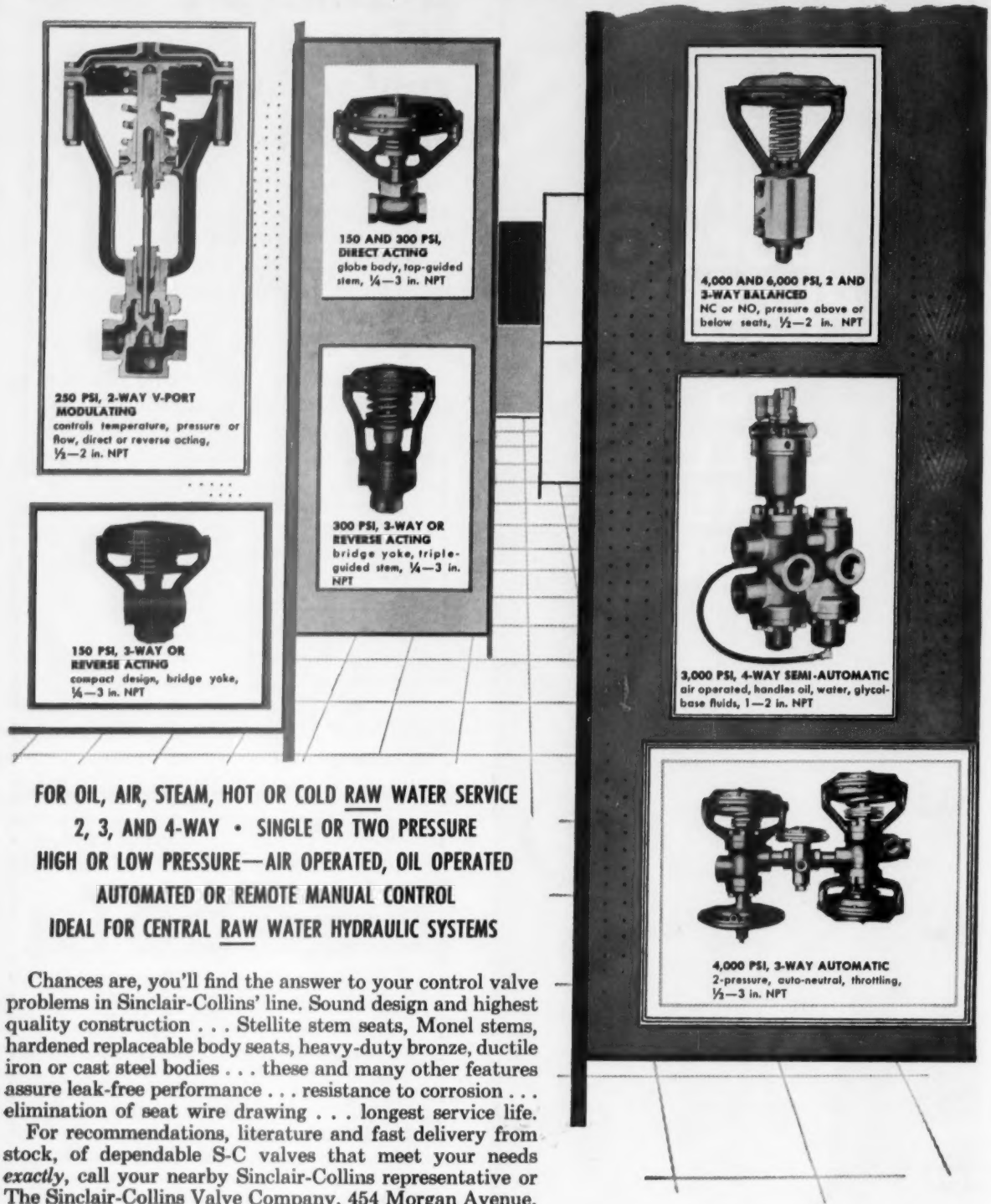
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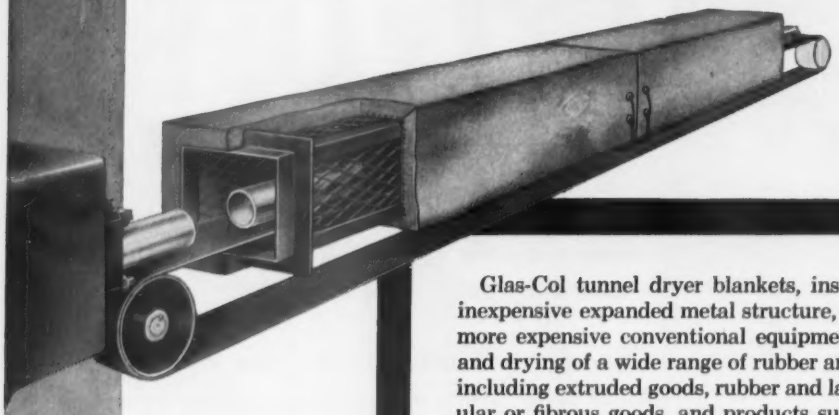

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PATENT REVIEW

by Melvin Nord

Polymerization of Butyl Rubber

U. S. Patent 2,834,762, issued May 13, 1958, to Charles A. McKenzie and Robert F. Killey, assigned to Polymer Corp. Ltd., relates to the low temperature polymerization of isobutylene and isoprene.

This patent is an improvement on U. S. Patent 2,529,318, by Tegge, and is based on the discovery that fouling of the reactor system may be reduced, and hence a longer run obtained and/or higher concentrations of monomer and polymer permitted, by maintaining the frozen film of polymer on the refrigerating heat exchange surface throughout the reaction and preventing appreciable erosion of this film during the reaction.

The maintenance of the frozen film, in other words the prevention of any periodic melting of the film, is effected by keeping the reaction mixture at a low enough temperature. The erosion is prevented by using a reduced speed of circulation of the reaction mixture.

Shaping and Vulcanizing Apparatus

U.S. Patent 2,842,796, issued July 15, 1958 to Thomas J. Rhodes, and assigned to United States Rubber Co., describes an extrusion apparatus for continuously producing a running length of vulcanized rubber sheet.

As shown in Figures 1 and 2, the apparatus consists of a rotary vulcanizing assembly (10) in combination with an extrusion head assembly (11), to which vulcanizable rubber stock is fed continuously under pressure by a stuffer assembly (13), the entire arrangement being supported on a suitable base framework (14).

The stuffer assembly is made up of a stuffer barrel constructed in two sections (16 and 17) for ease of assembly. It may be provided with conventional internal heating means (not shown) for heating the rubber stock being extruded to working temperature. An axial bore (18) within the stuffer barrel contains a rotatably mounted stuffer screw (19) which extends at its rear or feed end into a gear box (20). The screw is rotated at a desired rate of speed under the influence of a variable speed driving motor (21). A feed opening (23) in the upper portion of the rear or entrance section (16) of the stuffer barrel communicates with the stuffer bore (18) and screw (19) for the purpose of charging the raw rubber stock to the stuffer assembly.

Vulcanizable rubber stock (12) is fed into the

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RIGHT: PARACRIL OZO HEEL on the other test shoe is still like new, while standard oil-resistant heel at left is worn smooth and beginning to crack.

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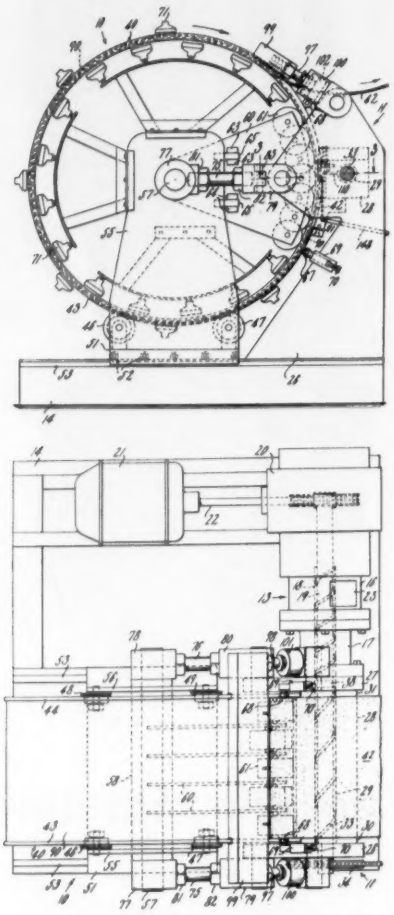
PATENT REVIEW

entrance opening (23) of the stuffer assembly (13), and the stuffer screw (19) is rotated by the variable speed driving motor (21) at such a rate as to deliver continuously and positively the required volume of rubber stock. Under the influence of the pressure exerted by the action of the



Figures 1 and 2

stuffer screw, the raw rubber stock streams into and fills entirely the extrusion bore (29) of the extrusion head assembly. At the same time, the extrusion head screw (33) is rotated at a carefully controlled rate by means of a variable speed transmission.

Exact control of the rate of rotation of the extrusion head screw is necessary because it has been found that uniform delivery of rubber stock throughout the length of the longitudinal extrusion passageway opening out of the forward side of the extrusion head bore (29) can be achieved only in this fashion. In general, the critical speed

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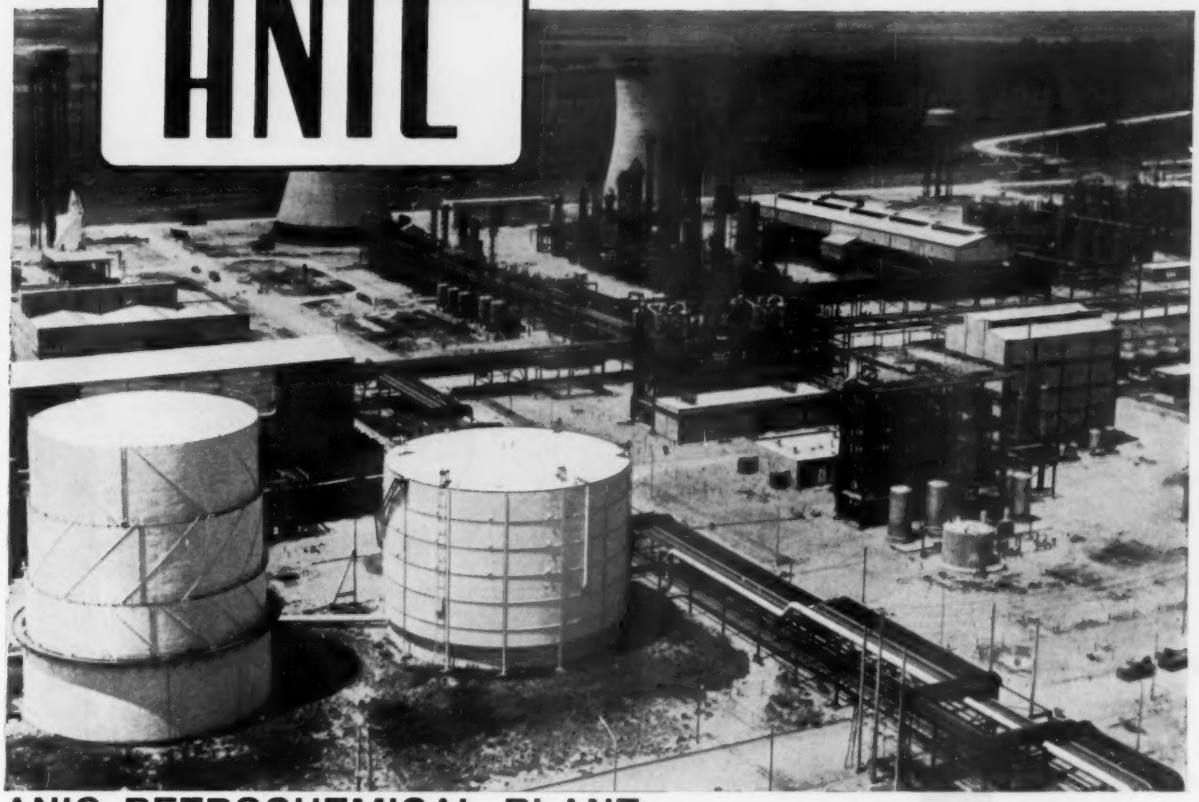

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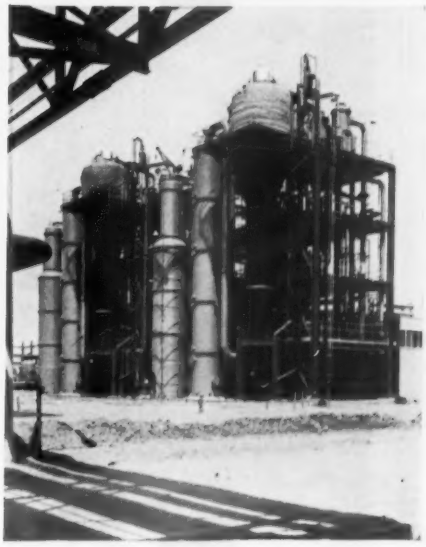
" 1503	" 1006
" 1708	" 1009
" 1712	" 1018



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of the extrusion head screw will not be the same as the speed of the stuffer screw.

The thus-extruded rubber stock proceeds along the extrusion passageway (110) and through the downward slanting portion thereof, defined between the surfaces 125 and 126 of the forward extrusion head parts, to the exit orifice 130 from the die head, as shown in Figure 3.

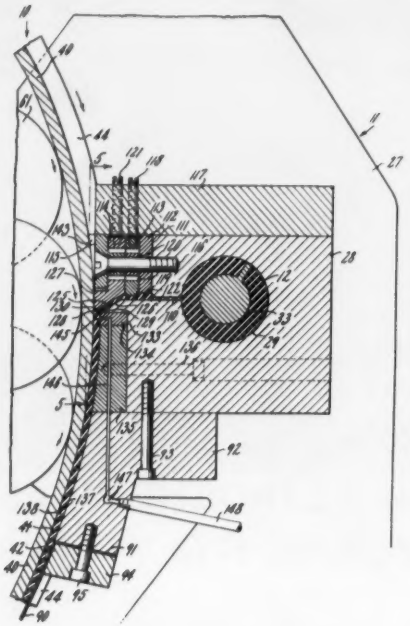
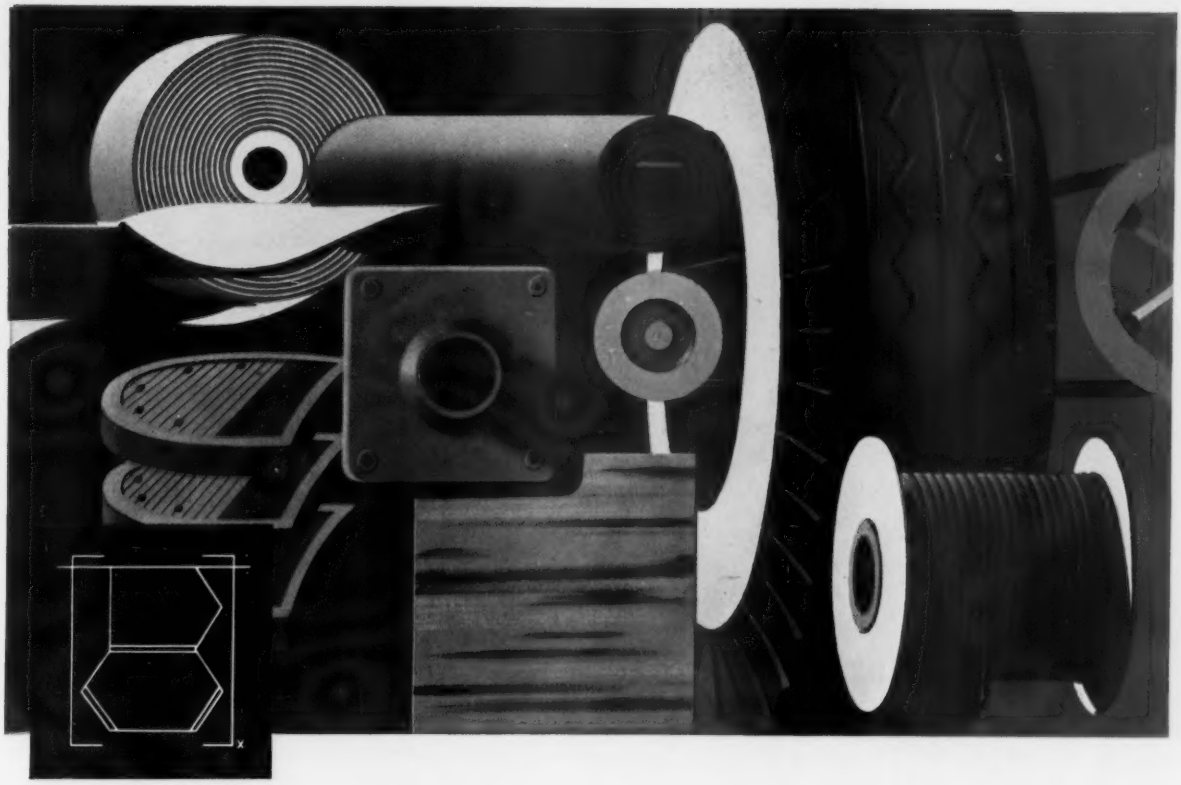


Figure 3

The rubber frictionally contacts the drum and causes the drum to rotate on its axis at a speed equal to the speed of advancement of the rubber, that is, there is no relative movement between the rubber and the surface of the drum, but the rubber and the drum move together as a unit.

When the advancing rubber sheet (42) has passed entirely around the drum as far as the termination of the band at the end bar (99), appreciable tension is then applied to the band by exerting appropriate hydraulic pressure within the upper portions of the tensioning cylinders (100 and 101). The rubber sheet is thus confined under pressure at each of its faces between the outer surface of the drum and the inner surface of the band, and at its edges the sheet is confined by the drum flanges (43 and 44) which it contacts. The rubber is maintained under a pressure sufficient to prevent blowing during the cure, such pressure suitably being about 40 psi or more.

Radiant heaters (71) are so regulated as to maintain a temperature sufficiently elevated to



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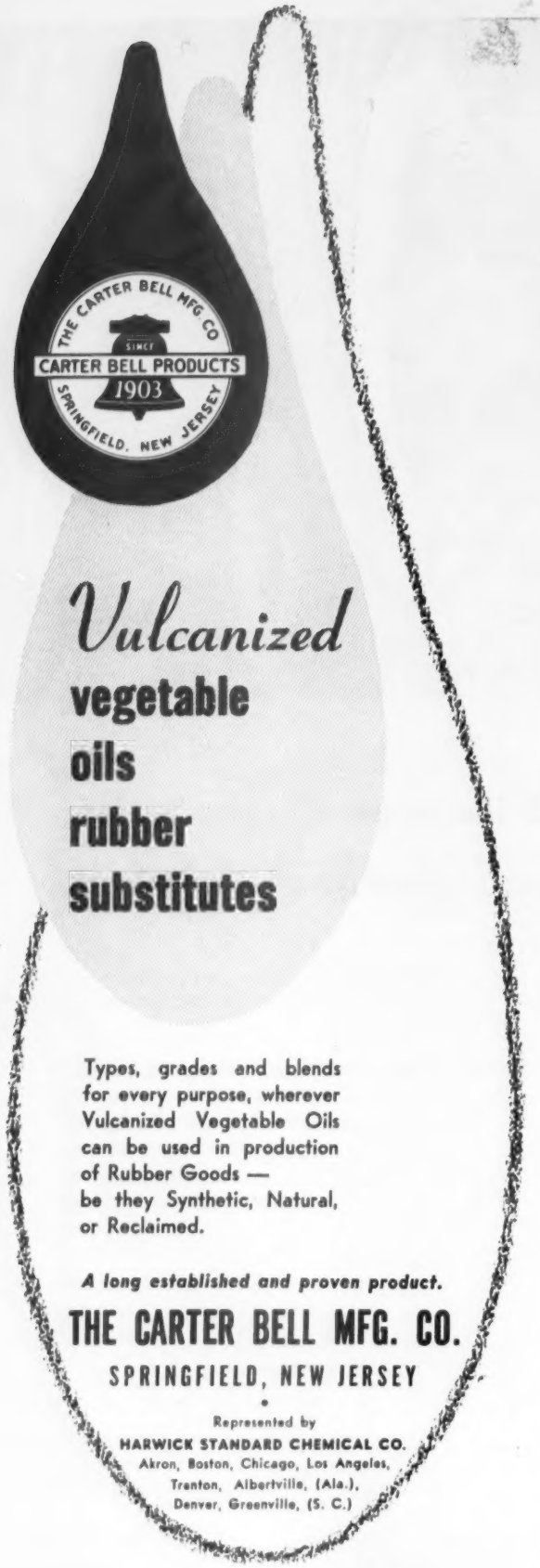
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PATENT REVIEW

cause the rubber sheet (42) to become substantially vulcanized as it passes around with the drum. The vulcanized sheet passes out at the termination of the band at the end bar (99) and the sheet may be wound up into a roll by a suitable wind-up device (not shown) as fast as it emerges from the apparatus under the influence of the extrusion pressure.

Condensation of Chlorinated Rubber

U.S. Patent 2,838,587, issued June 10, 1958 to Marcel Prettre, Edouard Grimaud, and Rene Allirot, assigned to Societe d' Electro-Chimie, d'Electro-Metallurgie et des Acieries Electriques d'Ugine, describes a method of condensing chlorinated rubber with aromatic compounds.

A mixture containing one part of chlorinated rubber, 20 to 300 parts of a neutral aromatic compound (an aromatic hydrocarbon or its alkyl or halogen derivative), and 5 to 20 parts of an inorganic halide condensation catalyst (aluminum chloride, ferric chloride, stannic chloride, or boron fluoride) is heated to a temperature below 130°C. until the production of acid ceases. Then the condensation product is leached with an acid medium until the catalyst is completely eliminated from the product.

Retardation of Ozone Cracking

U.S. Patent 2,843,643, issued July 15, 1958 to William K. T. Gleim, and assigned to Universal Oil Products Co., discloses a method of retarding the ozone cracking of rubber. The method consists of adding 0.25 to 10% by weight of demethylated wood tar distillate to the rubber.

Other Patents Of Interest

Subject	Assignee	Patent No.	Date
Tire building machine	General Tire & Rubber Co.	2,838,091	6/10/58
Self-cleaning butyl rubber vulcanizates	Esso Research & Engineering Co.	2,839,117	6/17/58
Tire cords and fabrics	Commonwealth Engineering Co. of Ohio	2,839,119	6/17/58

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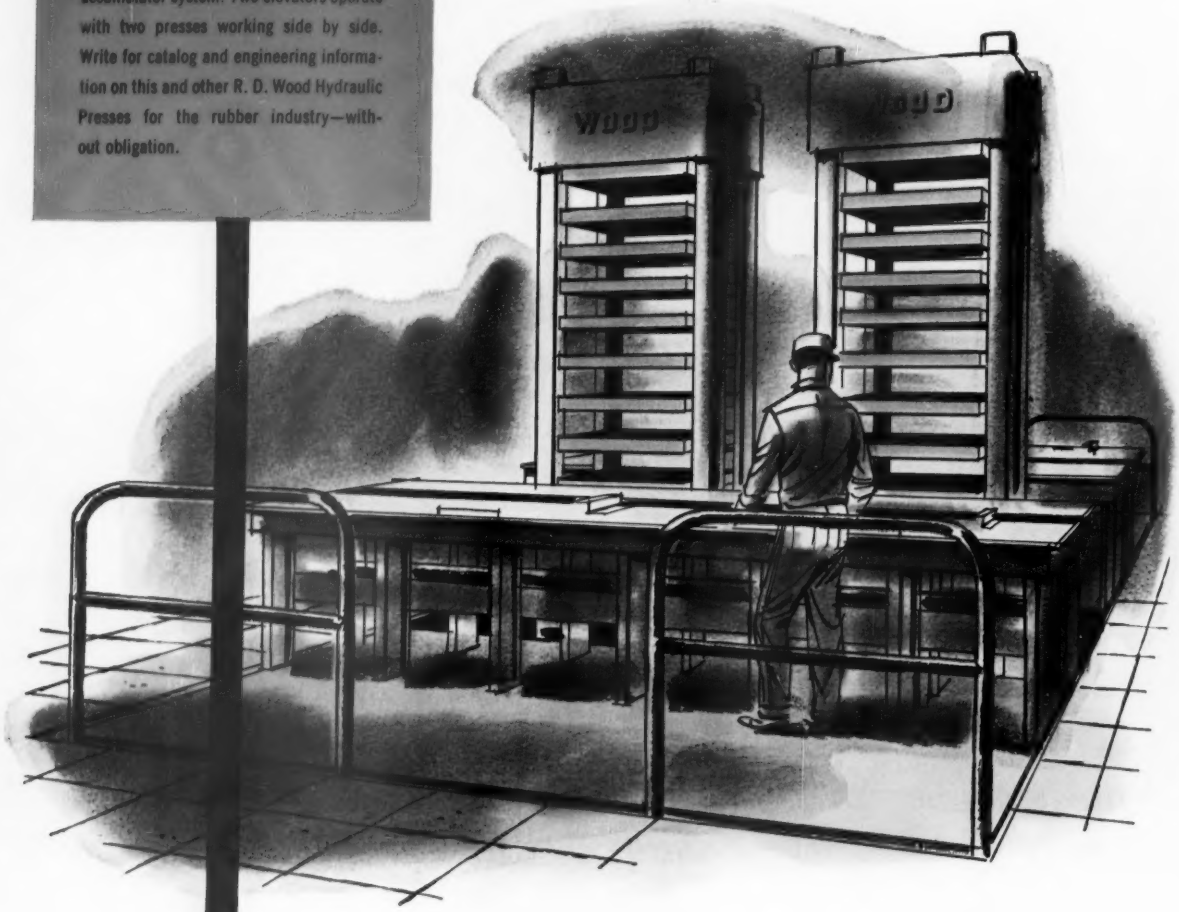

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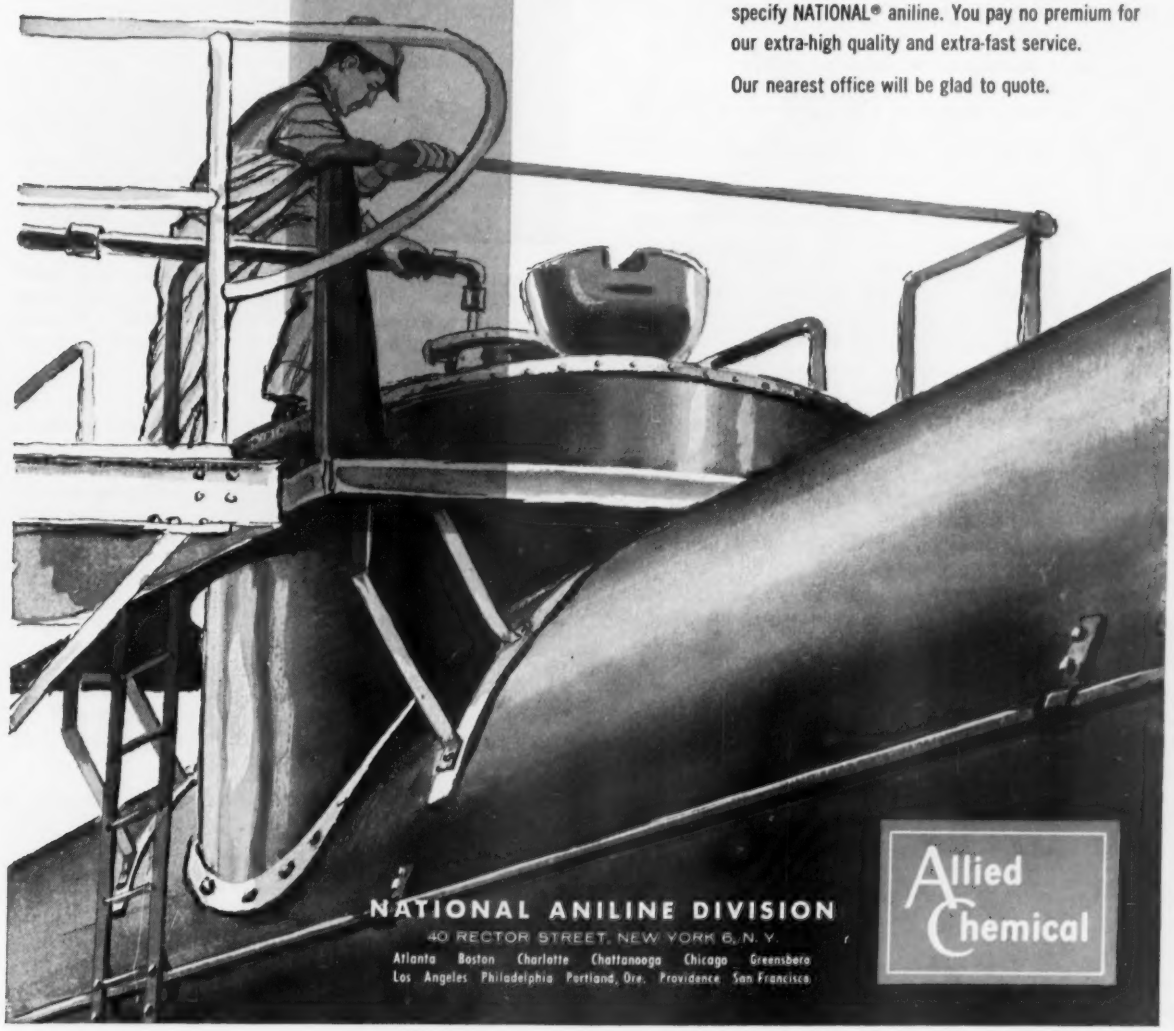

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Absolute protection of your rubber products is assured when you use UOP 88 or 288. At the UOP research laboratories, new antiozonant formulations are continually being tested in a variety of base stocks. In addition, many manufacturers have tested UOP antiozonants in their own laboratories and in use. One customer recently reported that in a test of UOP 88 in their base stock, the UOP antiozonant afforded complete protection for 230 hours of exposure under fixed conditions of strain of 50 pphm ozone. Another antiozonant used in the same recipe failed and the tire cracked after only 30 hours exposure, while the unprotected base stock cracked in 5 hours.

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3. Reinforcing agent.
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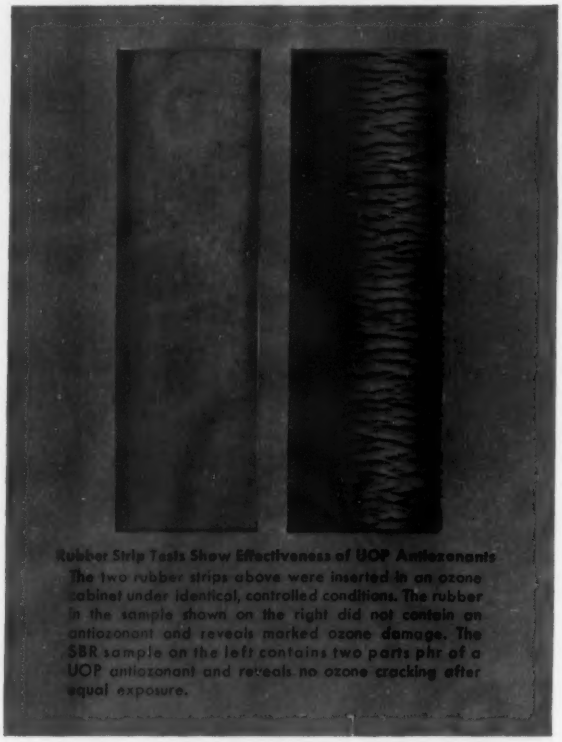
5. Conditions of use, including type of stress, ozone concentration, temperatures.



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The two rubber strips above were inserted in an ozone cabinet under identical, controlled conditions. The rubber in the sample shown on the right did not contain an antiozonant and reveals marked ozone damage. The SBR sample on the left contains two parts phr of a UOP antiozonant and reveals no ozone cracking after equal exposure.

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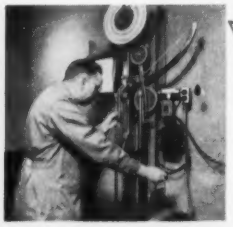

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COMING EVENTS

Jan. 23, 1959. Akron Rubber Group, Sheraton Hotel, Akron, Ohio.

Jan. 23, 1959. Philadelphia Rubber Group, Poor Richard Club, Philadelphia, Penna.

Jan. 26-29, 1959. Plant Maintenance & Engineering Show, Public Auditorium, Cleveland, Ohio.

Jan. 29-31, 1959. Southern Rubber Group, Statler Hilton Hotel, Dallas, Texas.

Jan. 30, 1959. Chicago Rubber Group, Furniture Club, Chicago, Ill.

Feb. 2, 1959. Washington Rubber Group, Army-Navy Club, Washington, D. C.

Feb. 2-6, 1959. ASTM Committee Week, Penn-Sheraton Hotel, Pittsburgh, Penna.

Feb. 3, 1959. Los Angeles Rubber Group, Biltmore Hotel, Los Angeles, Calif.

Feb. 4-6, 1959. American Society for Testing Materials, Committee D-11, Pittsburgh, Penna.

Feb. 6-8, 1959. Boston Rubber Group, Annual Ski Week-End, White Mountains, N. H.

Feb. 12, 1959. Fort Wayne Rubber & Plastics Group, Winter Meeting, Van Orman Hotel, Fort Wayne, Ind.

Feb. 18-21, 1959. International Automotive Service Industries, Navy Pier, Chicago, Ill.

Feb. 27, 1959. Quebec Rubber & Plastics Group, Ladies Night Dance, Victoria Hall, Montreal, Canada.

March 3, 1959. Buffalo Rubber Group Spring Meeting, Hotel Westbrook, Buffalo, N. Y.

March 13, 1959. Chicago Rubber Group, Furniture Club, Chicago, Ill.

March 19, 1959. Quebec Rubber & Plastics Group, "Reclaimed Rubber-Panel Discussion," Montreal, Canada.

March 20, 1959. New York Rubber Group, Technical Meeting, Henry Hudson Hotel, New York, N. Y.

April 3, 1959. Akron Rubber Group, Sheraton Hotel, Akron, Ohio.

April 6-8, 1959. Building Research Institute 8th Annual Meeting, Penn-Sheraton Hotel, Pittsburgh, Penna.

April 16, 1959. Fort Wayne Rubber & Plastics Group, Spring Meeting, Van Orman Hotel, Fort Wayne, Ind.

April 16, 1959. Quebec Rubber & Plastics Group, "Rubber & Plastics Extrusion," Montreal, Canada.

April 24, 1959. Chicago Rubber Group, Furniture Club, Chicago, Ill.

May 1, 1959. Joint International Meeting, Buffalo Rubber Group-Ontario Rubber Section, C.I.C., Hotel Sheraton-Brock, Niagara Falls, Ont.

May 1, 1959. Philadelphia Rubber Group, Poor Richard Club, Philadelphia, Penna.

May 12-15, 1959. Division of Rubber Chemistry, A.C.S., Spring Meeting, Biltmore Hotel, Los Angeles, Calif.

May 25-27, 1959. Chemical Institute of Canada, 42nd Annual Conference, Halifax, Nova Scotia.

June 4, 1959. New York Rubber Group, Summer Outing.

June 5, 1959. Fort Wayne Rubber & Plastics Group, Summer Outing.

June 5, 1959. Quebec Rubber & Plastics Group, Golf Tournament.

June 9, 1959. Buffalo Rubber Group, Golf Outing, Lancaster Country Club.

June 9-12, 1959. Material Handling Institute Exposition, Public Auditorium, Cleveland, Ohio.

June 12-14, 1959. Southern Rubber Group, Desert Ranch, St. Petersburg, Fla.

June 15-19, 1959. American Society of Engineering Education, Annual Meeting, Pittsburgh, Penna.

June 19, 1959. Akron Rubber Group, Summer Outing, Firestone Country Club, Akron, Ohio.

June 21-26, 1959. ASTM Annual Meeting, Chalfonte-Haddon Hall Hotel, Atlantic City, N. J.

Aug. 4, 1959. New York Rubber Group, Golf Tournament.

Sept. 13-17, 1959. National Tire Dealers & Retreaders Association, Annual Convention, Washington, D. C.

Sept. 24, 1959. Fort Wayne Rubber & Plastics Group.

Oct. 13, 1959. Buffalo Rubber Group, Fall Meeting, Hotel Westbrook, Buffalo, N. Y.

Oct. 16, 1959. New York Rubber Group, Fall Meeting, Henry Hudson Hotel, New York, N. Y.

Oct. 19-21, 1959. Ninth Canadian High Polymer Forum, Guild Inn, Toronto, Ont., Canada.

Oct. 23, 1959. Akron Rubber Group, Sheraton Hotel, Akron, Ohio.

Nov. 9-13, 1959. Joint International Meeting of Division of Rubber Chemistry, A.C.S.; Committee D-11, A.S.T.M., and Rubber and Plastics Division, A.S.M.E., Shoreham Hotel, Washington, D. C.

Dec. 3, 1959. Fort Wayne Rubber & Plastics Group.

Dec. 18, 1959. New York Rubber Group, Xmas Party.

Jan. 29, 1960. Akron Rubber Group, Sheraton Hotel, Akron, Ohio.

Feb. 11, 1960. Fort Wayne Rubber & Plastics Group.

April 8, 1960. Akron Rubber Group, Sheraton Hotel, Akron, Ohio.

April 14, 1960. Fort Wayne Rubber & Plastics Group.

May 24-27, 1960. Division of Rubber Chemistry, A.C.S., Spring Meeting, Statler Hotel, Buffalo, N. Y.

June 17, 1960. Akron Rubber Group, Summer Outing, Firestone Country Club, Akron, Ohio.

Sept. 13-16, 1960. Division of Rubber Chemistry, A.C.S., Fall Meeting, Commodore Hotel, New York, N. Y.

May 16-19, 1961. Division of Rubber Chemistry, A. C. S., Spring Meeting, Brown Hotel, Louisville, Ky.

Sept. 5-8, 1961. Division of Rubber Chemistry, Fall Meeting, Sherman Hotel, Chicago, Ill.

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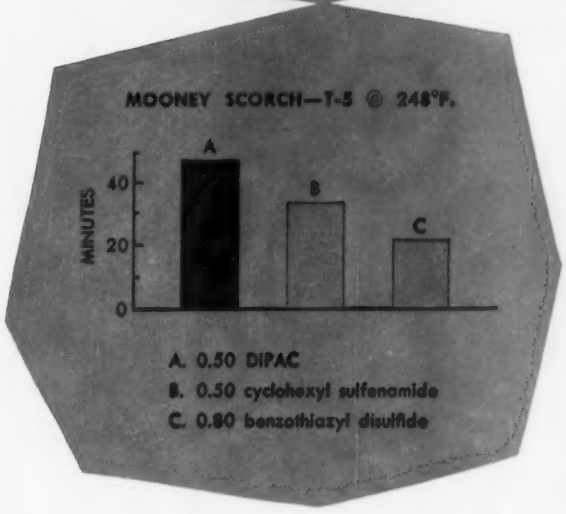

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Technical data and performance comparisons on DIPAC are given in our Bulletin S-121B . . . including studies on GR-S 1500 with HAF Black and GR-S 1712 with ISAF Black, as well as on smoked sheet rubber with ISAF Black. To get your copy . . . and a sample of DIPAC for your evaluation . . . just write or call Pennsalt.

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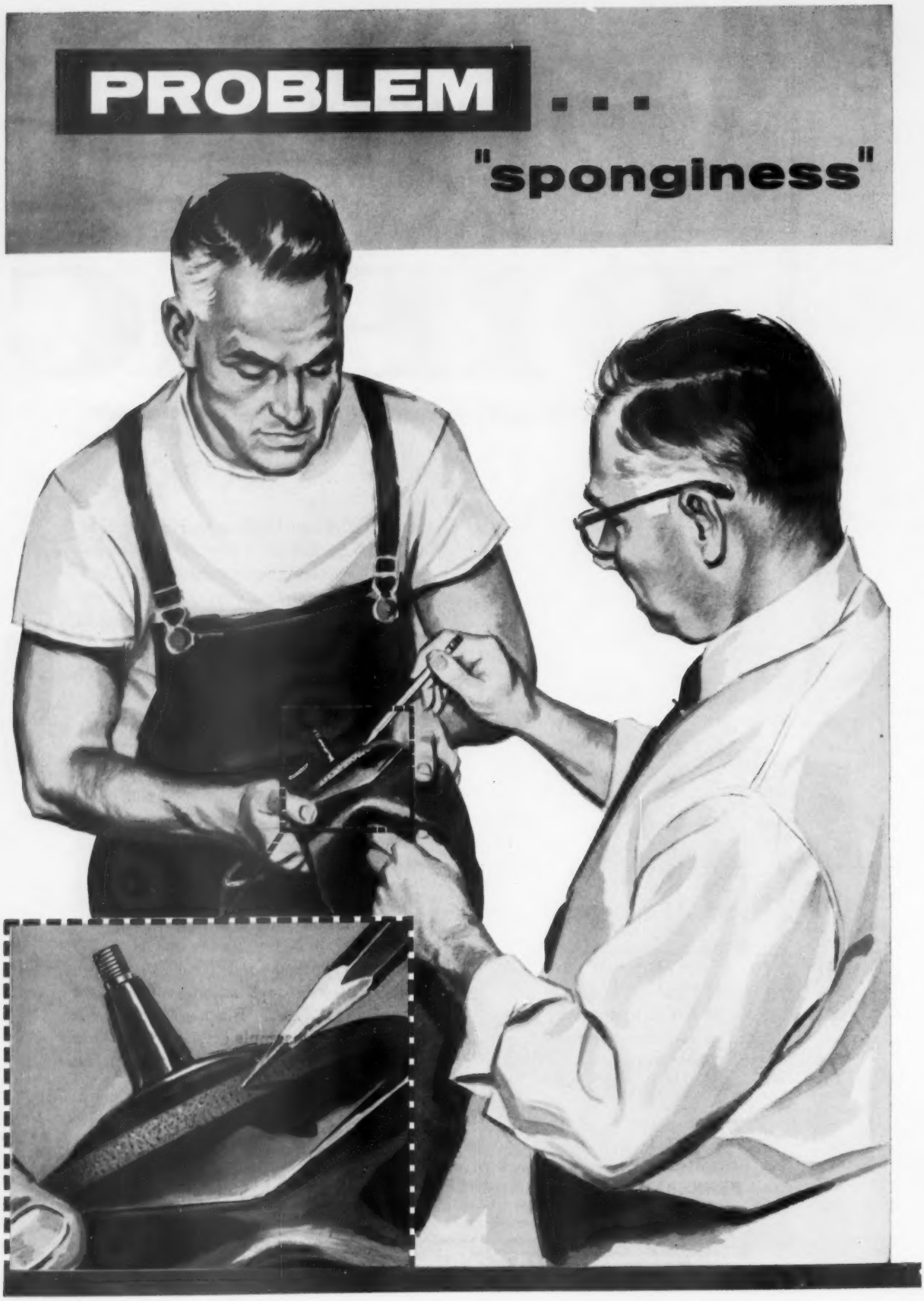
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There's no need to increase cure time—just add Kure-Blend MT to be sure of tube cure!

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The various reasons for this acceptance may be summed up thus: By virtue of years of experience with St. Joe pigments, consumers have come to know St. Joe's high and undeviating standards of quality and uniformity. *They rely on these factors to maintain or increase the quality of their own products.*

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Designers and Builders of Ferrous and Nonferrous Rolling Mills, Mill Rolls, Auxiliary Mill and Processing Equipment, Presses and other heavy machinery. Manufacturers of Iron, Nodular Iron and Steel Castings and Weldments.

As Soule Sees It...

Golden Anniversary

As William E. Hanford (Olin Mathieson Chemical Corp.) points out in a recent edition of *Industrial and Engineering Chemistry*, the year 1958 marked the 50th anniversary of the birth of that publication. In his newsy article, "Fifty Years of Organic Chemistry," Mr. Hanford cites a few of the spectacular products and processes which were unknown a few short years ago and which owe their existence to applied chemistry.

Among these are several items which are primarily used in the automobile industry, viz: tires, safety glass, and tetraethyl lead. While it is true that we have had automobile tires ever since the advent of the horseless buggy, in the old days it was par for the course to change tires at least once on any drive of 15 or 20 miles —now, if we get more than one flat a year, we feel cheated. Obviously, the rubber and fabric components, as well as the constructional details, have been tremendously improved.

The development of tetraethyl lead and its use in gasoline engines has saved this country millions of dollars and countless barrels of petroleum by stepping up the octane rating of gasoline.

The use of polyvinyl butyral as an interlayer in safety glass has also been responsible for spectacular savings to the automobile-using public—but here the most important savings have been in lives.

Other items cited are the Freons, without which electric refrigerators, food preservation and air conditioning would have been difficult, if not impossible—vitamins, insecticides, antibiotics, etc. The article is most interesting. We believe you will find it stimulating and well worth reading.

Adhesives

The subject of adhesives in the rubber industry is one that has tended to be somewhat in the magic, or mystery class. The reason for this is probably because the cements themselves were, or could be, made in small batches in the laboratory under strict supervision of the chemist, or technician, and when their use produced the desired adhesion, it seemed mysterious and spectacular to the uninitiated. Of course, when the materials to be stuck together refused to cooperate, it was also helpful to be able to explain the failure in scientific terms.

Actually, it seems to me that adhesives, as they apply to the rubber industry, are just now beginning to join with and become an integral part of the parent group, after being disembodied and in spectacular orbit for a number of years. It may be that the erstwhile boy-wonders will now assume their rightful place, as an adjunct to, and an important part of, the manufacture and use of rubber products. In other words, now that the boy-genius "C.E.Ment" has matured, it seems likely that he will realize that those who preceded him and built up the rubber business as we know it today, were pretty smart, also.

The appearance of a new magazine ADHESIVES AGE, on the rubber scene, should be of great benefit to all segments of the trade. Since it is to cover the "manufacture, application, technology, research, and marketing of adhesives," it will have an extremely wide appeal to all facets of the industry. This is particularly true, since the publication staff is largely made up of the same rubber pros who have so successfully master-minded RUBBER AGE, for many years, and the Editorial Advisory Board is composed of well-known industry experts.

Volume I, No. 1, October, 1958, of ADHESIVES AGE, got off to a good start with interesting articles on the theory and practice of modern-day adhesives, machines for mixing and dispensing cements, test methods, pictures of commercial applications, and many other worthwhile features.

Sweet Talk

Some interesting facts about non-caloric food and drink sweeteners, chiefly, sucaryl and saccharin, have recently been revealed. It is common knowledge that the use of these synthetic sweeteners has been growing steadily, but until 1957, no comprehensive production figures were available. Now, the U. S. Tariff Commission data for 1957 shows a combined production figure for sucaryl and saccharin of 2.1 million pounds. No breakdown is available as to the actual volume of each material produced, but it is known that the combined total sales of the two products for 1957, came to $3.8 million.

The present outlets for synthetic sweeteners are chiefly in dietetic and diabetic foods and beverages. In the former, the consumption seems likely to keep on increasing, since losing weight as painlessly as possible

Kenneth J. Soule

► Kenneth J. Soule recently retired as manager of the Manhattan Laboratories of the Manhattan Rubber Division of Raybestos-Manhattan, Inc., Passaic, N. J. A graduate of the University of Washington, cum-laude, Mr. Soule started with the firm as a chemist in 1919 after serving with the Chemical Warfare Service in World War I. He has worked extensively on transmission and conveyor belt development and has helped to adapt new synthetics and other materials into its processes. He also helped to build the Manhattan Laboratories. Mr. Soule is a member of Phi Beta Kappa and Phi Lambda Upsilon Honorary Chemical Society. An active member of the A. C. S., he was chairman of its New York Rubber Group for one term.

continues to be a popular fad and this calls for non-caloric foods. In the field of diabetic foods, it is hard to see how the consumption of synthetic sweeteners will be reduced, as it appears highly probable that more and more people will find it necessary to adopt a mildly restricted diet, low in natural sugar.

In this connection, perhaps it would not be out of order to suggest that each one of you who has not had a recent test for excess sugar in your blood and urine, arrange with your doctor for such a check-up *right now!* I can highly recommend it. The tests are simple, quick and painless. You have nothing to lose, by having them made, except your unreasoning fear that you may already have diabetes. And if, by chance, you are one of the million odd persons who does have it in a mild form (see *Readers' Digest,* November, 1958, "Search for a Million Unknown Diabetics," and also "The Hunt for Hidden Diabetics," *Saturday Evening Post,* December 6, 1958), the sooner you find it out, the better.

The probabilities are good that you will be able to keep the disease in check by going on a special, reduced-sugar diet, and so avoid serious consequences later, such as a lifetime of daily insulin injections, or an unnecessarily shortened life. (P.S. If it should become necessary or desirable for you to go to artificially-sweetened desserts, puddings, canned fruits, etc., don't worry about it. When properly made, these foods are as tasty and delicious as their natural-sugar counterparts. In fact, I defy you to tell them apart, by taste.)

High Shine—No Waxing?

If the claims of the "Big Three" are borne out and the paint jobs on their new models do not require waxing or polishing for at least 2 to 3 years, it will be something of a minor miracle in the industry. It may also be a temporary blow to the makers and sellers of auto polishes and waxes. However, the huge used-car market still remains, and we also suspect that waxes and such will still be used to some extent, at least, on many of the new "dream-boats."

Incidentally, General Motors is using a new acrylic lacquer on their 1959 cars while Chrysler and Ford are relying on a high melamine enamel over a modified epoxy primer. The same source also notes that Eastman has a cellulose acetate butyrate coating in the works which stands up at least twice as long under hot, humid exposure as even the best of the new non-waxers.

Now if the rest of the car shows up as well as the new paint job, maybe Happy Days will be here again! . . .

High Temperature Elastomers

The search for elastic materials which would stand high temperatures and exposure to oils at one and the same time, really became a crash program with the development of the first synthetic oil for the J-47 gas turbine engine about 10 years ago.

In the November, 1958, issue of *Industrial and Engineering Chemistry,* Major William Postelnek of WADC, Dayton, Ohio, detailed the highlights of the steady progress which has been made on this problem by various companies working jointly with the Air Force, or independently. The elastomers covered included Teflon, Kel-F, Kel-F Elastomer, Poly FBA, (1F4), Silastic LS-53, Fluorinated Polyester Rubber, Kel-F 214, and Viton A.

Tables are included showing the original properties of compounds of these materials, and their resistance to high temperatures and di-ester type fluids. Whereas the best natural or synthetic rubbers swelled excessively in the fluids, and failed in short order at elevated temperatures, the best of the new compounds withstood 550°F. for 70 hours without much hardening and with satisfactory retention of tensile and elongation. In jet fuel or silicate-type fluids at 550°F. the volume change was negligible.

The latest Air Force-sponsored work at the University of Florida has developed a polymer from the "copyrolysis of a perfluoro-monoamidine and a diamidine" which shows 31 per cent weight loss after 30 minutes at 470°C. From this and other investigations, it seems quite possible that a break-through into space polymers which will withstand temperatures of over 1000°F. is just around the corner. Step Aside, Buck Rogers! . . .

Fire Resistant Conveyor Belts

David D. Marshall, chairman, British Rubber and Plastics Belting Manufacturers Association, recently detailed the situation regarding rubber conveyor belts in British coal mines and the developments leading up to the present status quo.

In September 1950, a particularly disastrous fire occurred in a British mine, the Cresswell Colliery. The fire originated in a quantity of natural rubber conveyor belting when it became jammed between the chute and the drum and caught fire due to the frictional heat. The conflagration spread rapidly along the belt installation and ultimately 80 miners lost their lives in the disaster.

The National Coal Board at once began an intensive search for a fire-resistant belt for underground installations. Neoprene would have been a logical initial choice, but since it was not, at that time, manufactured in Great Britain, economics ruled it out. PVC was the next choice, as it was readily available, and offered the necessary noninflammability.

Three years of intensive research and development work brought the matter to the point where the National Coal Board was ready to accept as much PVC belting as the manufacturers could produce. Within a period of two additional years, all new installations and all replacement belts for underground use were made of PVC type material.

Quoting directly from the article "Some idea of the size of the operation may be gained from the fact that at present the total length of underground conveyor belting in British mines is about 26 million feet."

In changing over to PVC it is estimated that about 7,000 tons of rubber per annum have been replaced by 8,000 tons of PVC. The total expenditure by the N.C.B. on PVC belting in 1957 was in the neighborhood of 19 million English pounds, (about $93 million).

(Of course, in the U. S. neoprene conveyor belting is largely used where fire resistance is a problem, but it seems to me that this British PVC development is nevertheless of considerable general interest.)

VINYL
UPHOLSTERY
PRODUCERS *who use Plastolein 9720 Polymeric*
have two unbeatable allies
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Time—the final judge of quality.
Plastolein 9720 Polymeric has excellent permanence, thanks to low volatility, low migration, and outstanding resistance to "wipe-off," heat and ultraviolet light. These qualities are a great comfort to our customers because they *know* their products will far outlast competitive products using monomeric plasticizers.

Cost—the powerful competitive edge.
Plastolein 9720 is the *lowest cost* polymeric plasticizer on the market today. In addition, its relatively low viscosity makes processing easier and permits the economies of bulk shipping, storage and handling.

Why not get both these advantages on *your* side? Write Dept. U-1 for booklet titled "Plastolein Plasticizers."

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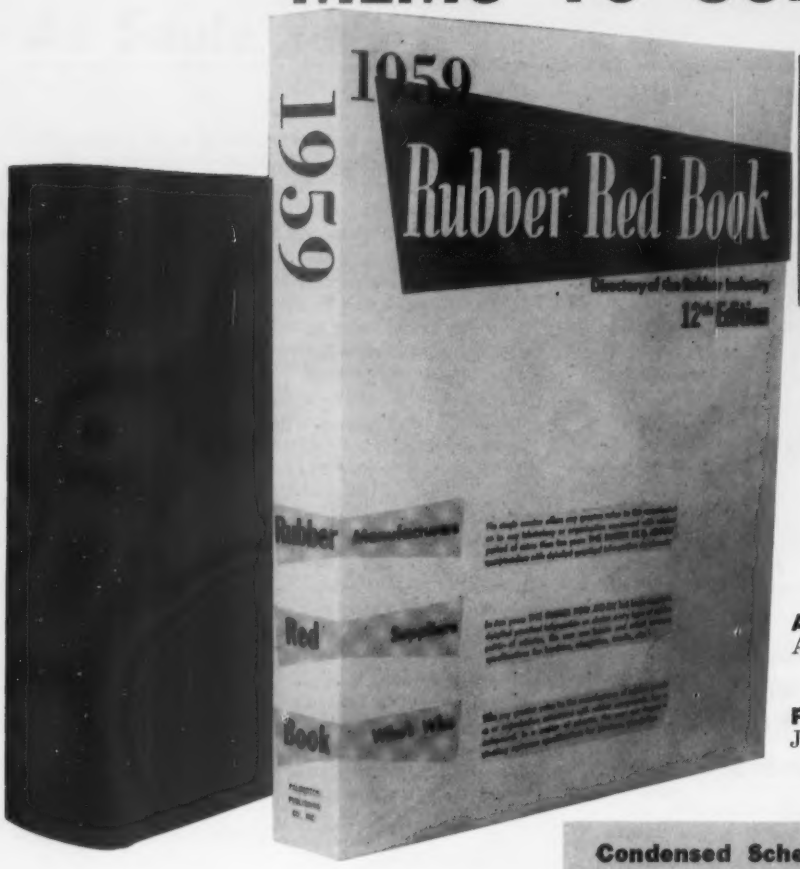
MEMO TO SUPPLIERS...



Advertising Closing Date:
April 15, 1959

Publication Date:
June, 1959

Condensed Schedule of Rates—1959 Edition

Space	Number of Units, Each 1	2	3	4 or more
Page	$200	$195	$190	$185
2/3 page	155	150	145	140
1/2 page (island)	135	130	125	120
1/2 page	110	105	100	95
1/3 page	85	82	79	76
1/6 page	50	48	46	44

Sales Agents Section:

In addition to standard space units, there is available in this section only, a special unit measuring 1-3/8" deep by 3-3/8" wide @ $38 each.

For complete rates and sizes write for 1959 rate card.

Mail Coupon Today

..... (date)

RUBBER RED BOOK
101 West 31st Street, New York 1, N. Y.

Please reserve the following space for us in the 1959 edition:

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We agree to pay for this at the rates shown in your rate card.

Company .....

Address .....

Signed By ..... **Title** .....

1959 is RUBBER RED BOOK Year—

Reserve Your Advertising Space Now.

• Directory To Become Annual Publication

The rubber industry has grown at such a rapid pace in recent years as to create problems for publishers of reference source material. This has been especially serious for RUBBER RED BOOK because the two year lapse between editions meant lengthy delays in correcting hundreds of listings. The Directory's value as a source of authoritative and up-to-date information is materially reduced when such changes are delayed. Because the number of changes increases with the growth of the industry, the publishers have decided to place RUBBER RED BOOK on an annual basis, starting with the twelfth edition in 1959.

• New Format

Several other changes are to be made in RUBBER RED BOOK, among them a new over-all page size of 8¼ x 11¼", with the type page size being 7 x 10". This larger page size means much more information on each page. In addition, a soft, flexible cover will be substituted for the previous hard binder, thus reducing bulk and making the Directory easier to handle.

• Economy

The new page size enables advertisers to use the same advertising plates prepared for standard sized monthly journals such as RUBBER AGE and ADHESIVES AGE, thus eliminating costly production charges involved when separate smaller plates are required.

• New Advertising Units

The new page size makes possible a wider choice of advertising space units than formerly. Advertisers may now select from full pages, two-thirds pages, three kinds of half-pages, two kinds of one-third pages, and one-sixth pages.

• Advertising Page Rate Unchanged

A page of advertising space in the 1959 RUBBER RED BOOK will cost the same as in the previous edition—$200. However, users of multiple advertisements will find lower rates in effect. An increasing number of advertisers are using multiple advertisements—each devoted to a single product or sales point—to tell the full story of their wares. The lower rates, shown in the condensed table, make this more attractive.

• Inserts Now Possible

Now possible for the first time is the use of inserts or even catalog inserts. Advertisers may now use a single or double leaf insert prepared by their own printers or may even avail themselves of a new service—the printing of catalog inserts by the publisher. Under this plan, the publisher prints enough inserts (of 4, 8, 12 or 16 or more pages) to be bound into the Directory and furnishes additional inserts (complete catalogs) for distribution by the advertiser through his sales staff, etc. Rates for this service are based on the size of the catalog and the total number required.

• Directory Covers Field

There will be no change in the method of distributing RUBBER RED BOOK. Key personnel, representing the major buying influences in every rubber goods manufacturing plant in the United States and Canada, will receive personal copies of the 1959 RUBBER RED BOOK. This will account for more than 2,000 copies. The sale of extra copies to rubber companies, suppliers, libraries, exporters, etc., will bring the total distribution of the 1959 edition to more than 4,500 copies. Sale price of the 1959 edition will be $15.00.

• Publication and Closing Dates

Publication is set for June and the publishers will have the 1959 edition in the mails in the early part of the month. This will require an advertising closing date of April 15 by which time all advertising copy must be on hand.

• Order Space Now

To insure being represented with enough advertising space to tell the full story of your products, materials, equipment, services, place your order now—using the order coupon herewith or your own purchase order.

Publishers of **ADHESIVES AGE· RUBBER AGE· RUBBER RED BOOK**

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101 West 31st Street, New York 1, New York

WIRE SPECIALIZATION *for compatibility with rubber*

Never hesitate to contact National-Standard for technical help on meeting your wire requirements. As you may already realize, no other company has devoted so many years, or so much concentrated research and development, to the teaming of wire with rubber!

This specialized experience can work to your advantage . . . in determining exactly the right wire, cord, braid or tape . . . in helping you work out details of application, fabrication, wire size, strength, finish, adhesion and the many other variables.

So please remember, National-Standard service is always at *your* service.

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WAGNER LITHO MACHINERY, Secaucus, N. J.; *metal decorating equipment* • ATHENIA STEEL, Clifton, N. J.; *flat, high carbon spring steels* • REYNOLDS WIRE, Dixon, Ill.; *industrial wire cloth*

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POLYMEL
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lower prices - easier handling

A New Free-Flowing Powder For Compounding and Extending GRS. NATURAL RUBBER, NEOPRENE AND RECLAIM

Polymel's new Plasticil does the job better . . . faster . . . and more economically! This material has splendid softening action in natural rubber and GRS polymers and is highly compatible. Plasticil will not only act to give good flexibility, good abrasive resistance, excellent mold-ability, but it can be used from 5 to 35 parts on the rubber to obtain excellent processing without any deleterious effect on the physical properties of the finished product. Plasticil can be used to great advantage in Footwear Stocks, Sponge Compounds, Wire Insulation Compounds, Rubber Mats, Tires, Tire Tread Stocks, Footwear Materials and all types of mechanicals. It is practically free of any discoloring effects.

PRICES: Truckloads ... 11¼ cents • 5000 lb. Truckloads ... 11½ cents.
• 1 Drum to 5000 lbs. ... 11¾ cents.

AVAILABLE in any quantity. Write for FREE Sample and Technical Data, Now!

IT'S POLYMEL FOR compounding ingredients for Reinforcing, Plasticizing, Extending and Processing Natural and Synthetic Elastomers AND RELATED PRODUCTS.

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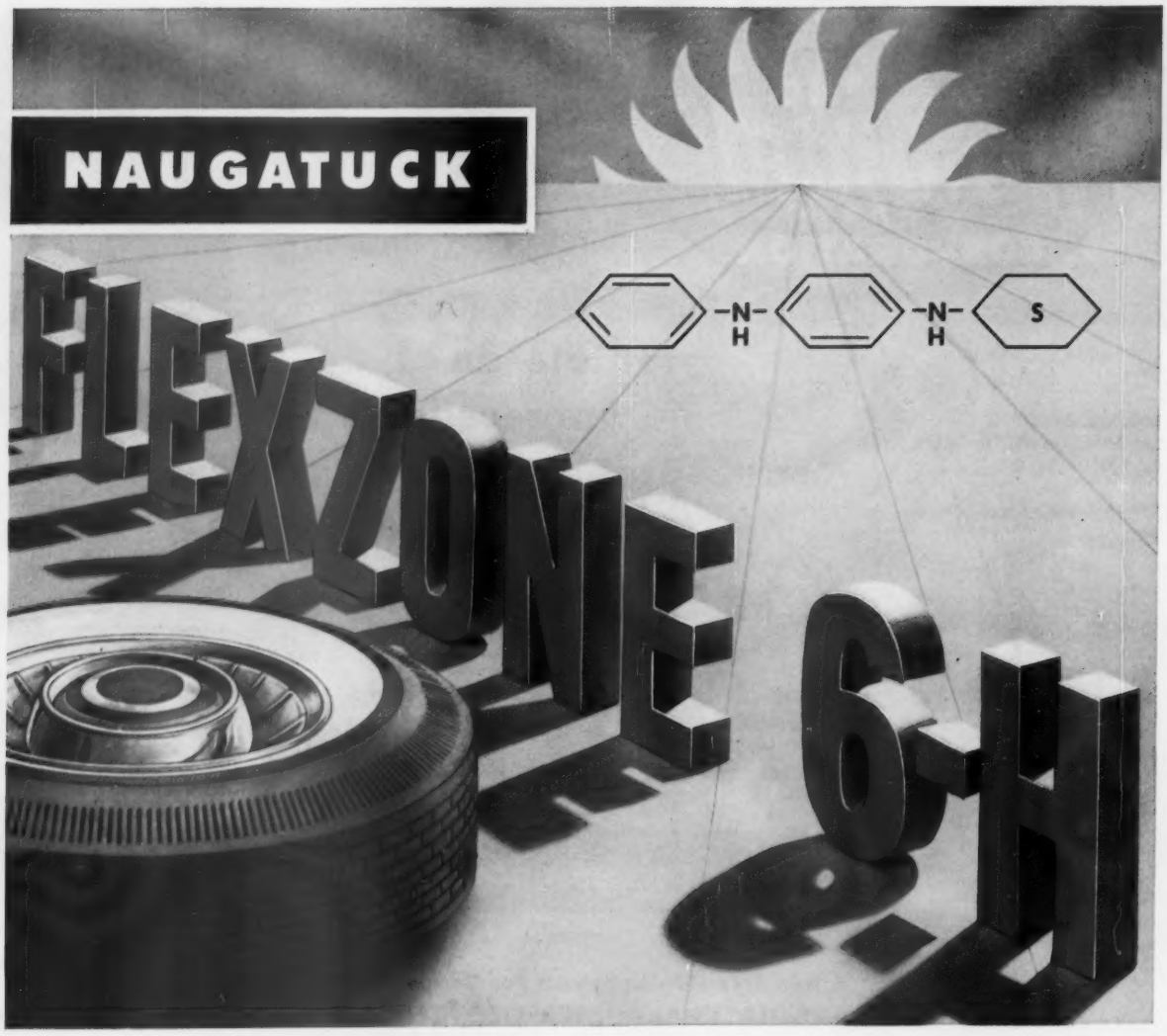

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antiozonant-antioxidant

Here's a new, all-purpose antiozonant-antioxidant that combines superior flex cracking resistance with outstanding resistance to weather and ozone attack. Highly effective against both heat and oxygen too, FLEXZONE 6-H is an excellent chemical for the improvement of age resistance and fatigue life of rubber products.

Since it is provided in free flowing powder form, FLEXZONE 6-H is cleaner and easier to handle than liquid antiozonants. It disperses readily in mill or Banbury mixes, and is essentially non-migratory.

Let FLEXZONE 6-H give *your* tire sidewalls, treads, retread rubber and other rubber products a new measure of resistance to weather, age, fatigue, and flexing. To learn more about FLEXZONE 6-H, contact your nearby Naugatuck representative or the address below.

Naugatuck Chemical

Division of United States Rubber Company 111R Elm Street Naugatuck, Connecticut

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1959
1958

REVIEW & PREVIEW OF THE RUBBER INDUSTRY

An editorial appraisal of the rubber industry and comments by industry leaders written expressly for the readers of RUBBER AGE

Editor's Round-up

THE GENERAL ECONOMY

The New Year seems to hold great promise of steady economic gains, accompanied by the usual 'growing pains,' equalling or surpassing the 1957 record by a wide margin in most fields.

► A year ago, Dr. Emerson P. Schmidt, chief economist for the U. S. Chamber of Commerce, whose forecasts for a decade have hit the bull's eye, declared that "an optimist these days is one who thinks that 1958 is going to be as good a business year as 1957."

There were some optimists then. In some specific industries, their optimism was justified. But by and large, the economic downturn Dr. Schmidt predicted for the first half did materialize. Few economists now seem inclined to dispute the fact that it was rough going for a while as the recession hit first one sector and then another.

There is not as much disagreement among business and federal economists now as there was last year at this time. Virtually all economic observers agree that 1959 will be a year of sustained economic growth. There is some difference of opinion as to how fast the economy will pick up speed. And some economists emphasize the problems ahead, rather than the opportunities. Nevertheless, just about everyone agrees that the New Year holds greater promise of much brighter economic horizons than did 1958.

Gross National Product to Climb

Dr. Schmidt, this year, is far more bullish than he was a year ago. He predicts that Gross National Product (GNP) will hit a $475 billion a year rate before 1959 is over. This would be up some $34 billion over 1958 and would represent the greatest increase in a single year in postwar U. S. history, except for 1955. Yet, only a few economists would shave his estimate and none of them could cut it significantly. "We should pass the $500 billion a year mark on GNP with ease in 1960," he adds.

What are the bases for this "planned optimism," as one economist calls it? They are not difficult to spot.

(1) The U. S. Departments of Labor and Commerce, in a joint release, have pointed out that construction will pass the $52 billion mark in 1959, going over $50 billion in a single year for the first time in history. Since a large share (more than 35 per cent) of this construction will be by local, state or federal governments, with the capital already in hand and the projects on the boards, there is not too much guesswork in this prediction, which, incidentally, has been phenomenally accurate for many years.

Construction actually was a bulwark of the economy in 1958, approaching $48 billion in dollar volume (higher than in 1957 and within a hair of the actual physical volume of the preceding high year. The total in 1959 will be higher both dollarwise and from a physical standpoint than the 1957 total.

Homebuilding is expected to play a dramatic role in the economy this year. Congressional leaders are determined to pump new credit into the field. The estimate is that more than 1,300,000 new homes will be started. Some optimistic observers expect the total to go higher.

(2) Personal income hit a new high of $360 billion a year rate as 1958 closed. This was true in spite of the fact that some 3.8 million persons still were classified as unemployed.

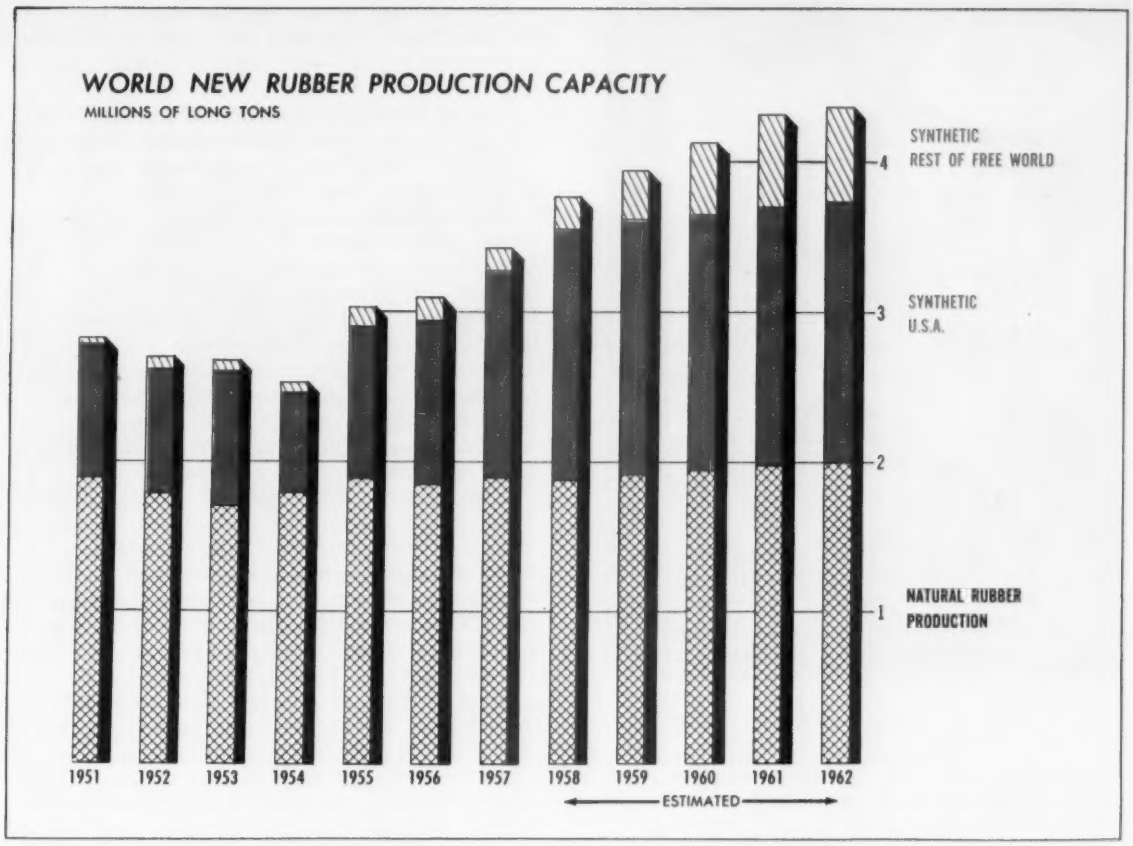
Employment Held at High Levels

One of the odd facts about the recession was that while unemployment increased to almost 5,000,000 at times (not counting those working only part-time), the number of persons holding jobs hovered around the all-time high of 1957. In one month, there was a new record set for number of persons employed, while the unemployed were getting the headlines.

It is likely that the number of unemployed will not be cut appreciably during the first half of 1959, although the number of jobs will increase. This is due to the steady growth of the work-force, of course. There were close to 66,000,000 persons gainfully employed in the last quarter of 1958, and it is confidently expected that this figure will be passed in the first half of 1959. Before 1959 is over, the number of employed may reach 67,000,000, if the GNP grows as predicted.

Even in April, 1958, when industrial production had fallen almost 14 percentage points in the Federal Reserve Board's Index of Industrial Production, personal income remained relatively high, being only one or two per cent under the previous all-time highs established in August, 1957. This was due to unemployment payments, a high dividend policy and the huge growth of the "service industry" in the U. S. By August, 1958, personal income again was hitting new highs, lending credence to the views of those who predicted a steady upturn.

(3) Population growth is a major factor in the thoughts of those who are predicting sustained economic growth. In recent years, the



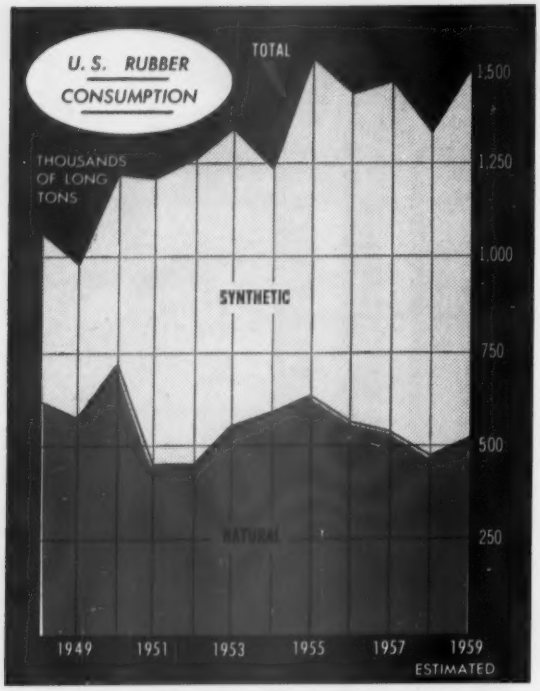
average of four million new births a year, plus immigration, plus increased longevity of the population, all have caused a fantastic increase in population, far over the most sanguine estimates of population experts. The population passed the 175,000,000 mark in the early fall of 1958. It is now predicted to hit 200,000,000 before 1965 and some experts believe that, unhampered by epidemics or other natural disasters, it might grow 98,000,000 by 1980. While it is recognized that population, per se, does not increase the wealth of a nation, it can serve as a powerful spur to industrial and commercial growth, granted credit policy and other factors are handled correctly. In a certain sense, the continued growth of the population is a vote of confidence—by millions of parents—in the future of the economy.

(4) The mysterious factor known as "consumer confidence" appeared to be getting a new lease on life as 1958 became a part of history. The Federal Reserve Board, in regular surveys, has striven to find out what people plan to buy, and how they feel about the future. The downturn, in a way, was forecast by consumers themselves in 1957, as they shrank their own prospective purchases and decided to "make do" with what they had in millions of homes. Previously, they had been "planning forward" confidently, when they began to sour on their own prospects. Apparently, they began to shrink their debts, cut their purchases, and increase their savings.

Even in the depth of the downturn, liquid savings were increasing at record rates. By the fall of 1958, the FRB surveys showed a partial return of consumer confidence. Yet, one family out of five still felt "bearish" about its own future. This fact alone made some economic observers feel that the upturn would be slower than it might be.

Business Men More Confident

(5) Businessmen are becoming slightly more confident in their planning for new plant and equipment. Although businessmen spent $37 billion on new plant and equipment in 1957, this figure dropped to a rate of $29 billion a year in the second quarter of 1958. It picked up a little in the third quarter and held steady in the fourth quarter. Most economists believe that this "breathing spell" in the feverish race to build and equip new facilities may have been good for business and the economy, in the long run. At any rate, they seem confident that



month by month in 1959, businessmen will revise upwards their future spending plans on new plant and equipment.

The principal reason some economists doubt that the economy will grow as fast in 1958 as their more optimistic confreres predict has to do with money and credit. Critics of the Federal Reserve Board have made much of the fact that it clamped down too hard on money and credit in 1957, when a loosening of the credit reins clearly was necessary. The same critics—mostly on Capitol Hill—now maintain that the FRB tightened credit again too soon after the upturn began, thus nipping a fast-paced recovery in the bud. They point to the upturn in loan applications by businessmen with the Small Business Administration and to abandoned, half-finished housing developments, as evidence of this new clamp-down on credit when, they say, "liberal" credit clearly was needed.

Liberal Credit Pledged

However, the new Congress is pledged to a policy of liberal credit, at low interest. Most of the new legislators and many of those re-elected used "tight money" as their principal plaint against opponents. This indicates that, by one stratagem or another, Congress may cause a relaxation of the credit reins. This will be one of the points of difference between the Republican White House and the Democratic Congress. Also, it should be kept in mind that a $10 billion federal deficit—clearly foreseen for this fiscal year, and likely for fiscal 1960, beginning July 1—will release a huge sum of new credit.

Viewed from the standpoint of January, 1959, the various economic developments considered "harmful" in 1958 may prove to be very helpful in giving life to the boom in 1959.

For instance, the cutting-down of inventories which went on apace all during 1958 was a big factor in the downturn, no doubt about it. As business came into the winter of 1958, it had reached rock-bottom in inventory reduction, most observers believed. Many businessmen, attempting to retain capital for other uses, cut too deeply and will be correcting that mistake in the coming months. The upturn in new orders to manufacturers clearly indicated this trend was taking place at year-end.

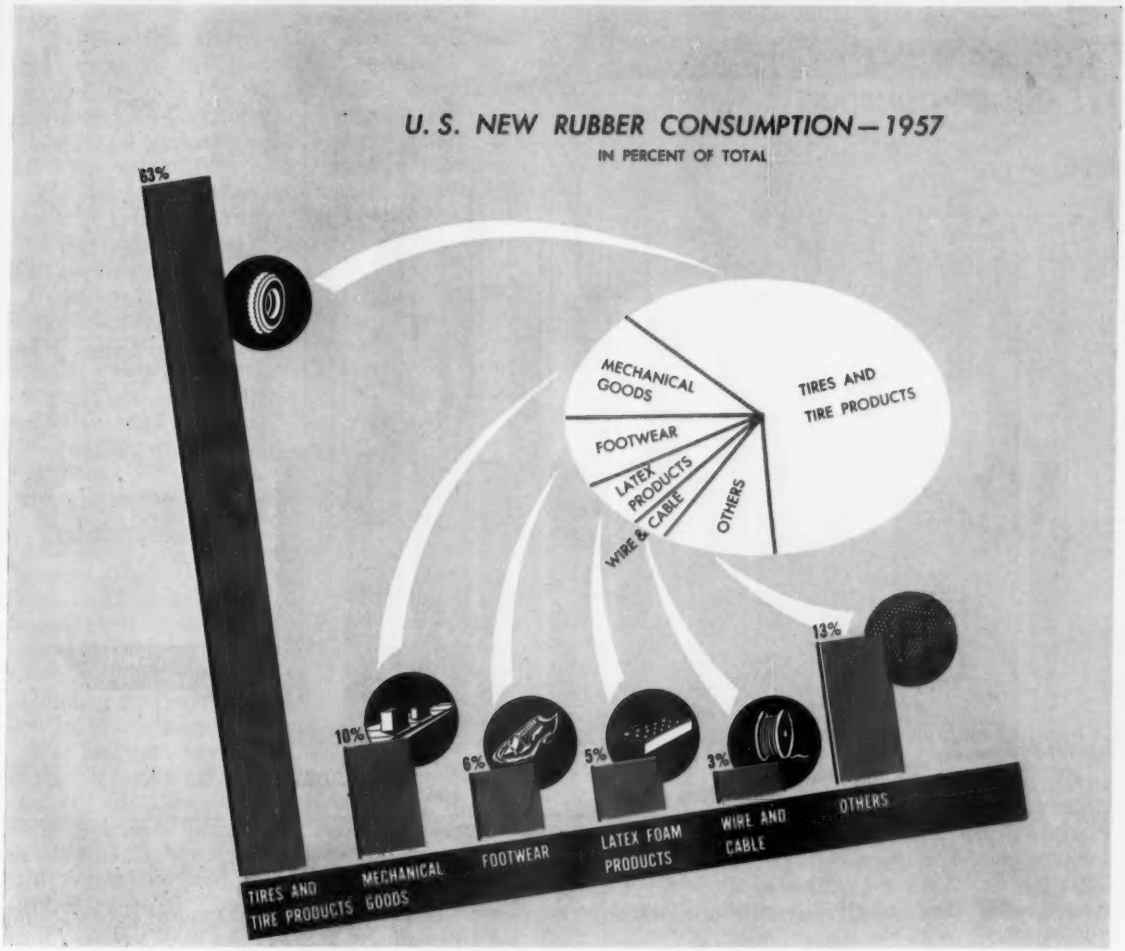
Also, the "washing out" of private debt in 1958, when millions of consumers liquidated their debts entirely, or worked them down to more manageable levels, can be good for 1959. Consumers clearly are in a better position to make substantial purchases now than they were a year ago. They have more savings and equity assets than ever before in history.

Even the "shaking down" that went on in industry after industry, causing failures, mergers, withdrawals from business and sell-outs, can be good for 1959, although it was tragic in 1958. The 4,200,000 businesses by and large are in a better position, management-wise and credit-wise, to face up to the competitive struggle in 1959 than many of them evidently were in 1958.

It is entirely possible—if not probable—that 1959 will prove to be another 1955, which represented the terrific rebound that took place after the recession of 1954. It all will depend on that indefinable will-o-the-wisp—consumer confidence. And this is such an individual matter, the only person who can do much about it is the businessman, in how he advertises, how he prices his goods, how he sells and services the consumer, and what collection methods he uses, among other factors.

Second-Half Inflation Probable

A degree of inflation is predicted for the second half of 1959, by many economists, as the full impact of the unbalanced federal budget hits the economy, and as new demands for higher wages are felt. About one-fourth of all manufacturers expected, as the year began, to raise prices to some extent in the first and second quarters, but most of them expected to keep prices steady. However, their attitude on the price front may be characterized as one of "watchful waiting." Economists believe that the pinch will show up by mid-year and that prices will turn upwards in full force in the second half.



THE RUBBER INDUSTRY

Leaders and economists in the industry believe that 1959 will come close to 1955 in some sectors and may surpass it in others. Recent developments make the outlook very bright.

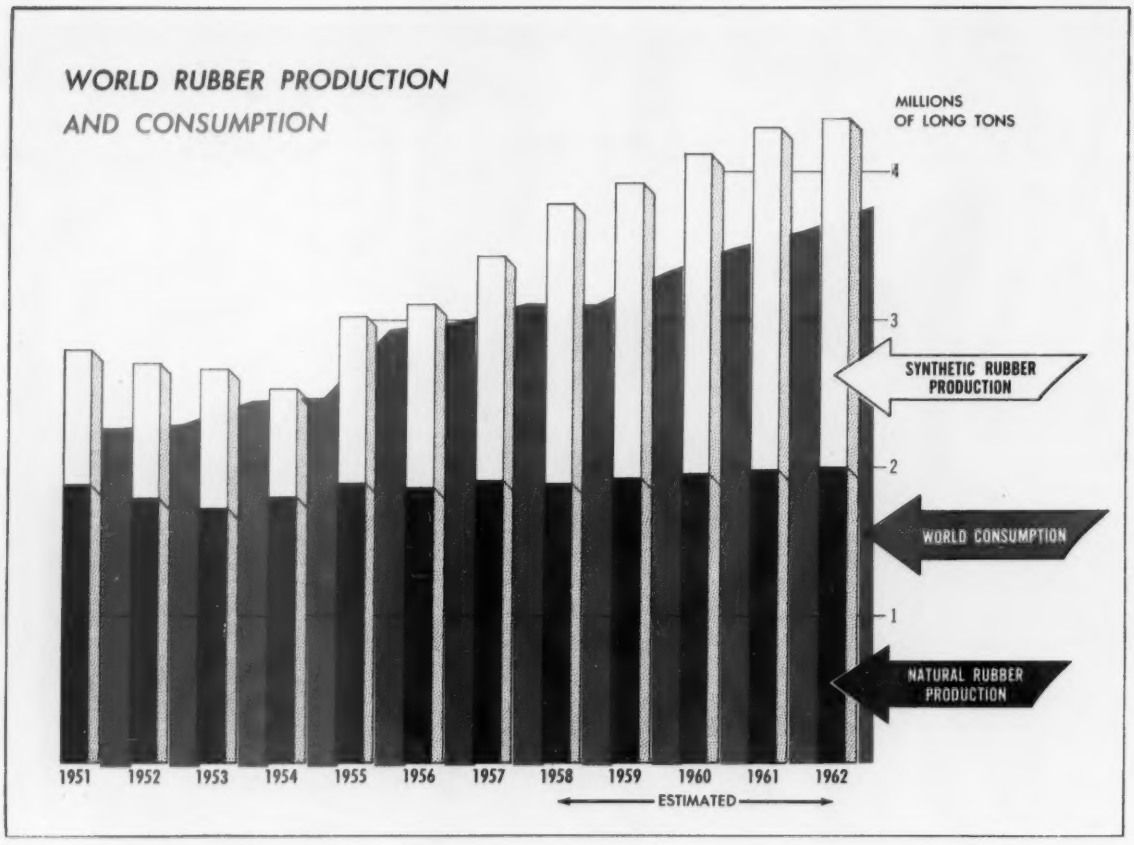
► Considering the over-all economic outlook for 1959, which we have reviewed, it may be lèse majesté to predict that the New Year will be the best year the rubber industry, in all segments, has enjoyed since 1955, and perhaps that some parts of the industry will top 1955 or any other year.

Experience—which many philosophers have termed "the only true guide to the future"—has shown time and time again that the rubber industry is among the most sensitive of all industries to changes in general business conditions. As Karl O. Nygaard, director of business research for the B. F. Goodrich Co., and member of the Statistical Committee of the Rubber Manufacturers Association put it recently:

"An increase or a decrease in total industrial output is greatly magnified in rubber industry trends."

This was proved most poignantly during the early 1958 downturn. Beginning in August, 1957, the same month in which a decline in total industrial production became noticeable, the rubber industry turned downwards. In the eight months following, the monthly production rate in rubber manufacturing, as measured by the Federal Reserve Board's Index of Industrial Production, went down 21 per cent. Only the automotive, electrical machinery and primary metals industries fared as badly, or worse.

Almost all rubber industry forecasts in late 1957 were optimistic, compared to what actually happened during the first half of 1958. Mr. Nygaard, discussing this phenomenon, pointed out that production in some areas of the industry went ahead, after August, 1957, as if



future sales were not already rolling down the hill.

"The sun was shining out the front window, but it was raining in the backyard," he said.

This was due (1) to inadequate statistical tools; (2) faulty interpretation of available data, and (3) the unusual nature of the recession itself.

Economists in the rubber industry long have known that without month-by-month reliable statistics on the production, sales and inventories of industrial rubber products, it would be difficult, if not impossible, to gauge accurately, in advance, just how the industry might be affected, or when.

Rubber industry economists, like those in the Federal Reserve Board and many another authoritative group, apparently did not gauge correctly in the "bearish" outlook of consumers, as shown in the FRB's survey of consumer buying plans. They also did not take into account the fact that many individuals and small businessmen were finding it extremely difficult to get any kind of credit help from their usual commercial sources, plus the sources of the Federal Government.

The two biggest factors causing the decline in the rubber industry in 1958 may well have been (1) the downturn in capital goods spending by business, and (2) the liquidation of business inventories. The combined dollar loss in production from these two sources—capital spending and the inventory shrinkage—was equivalent to about 80 per cent of the decline in GNP during the last three months of 1957 and the first three months of 1958.

That the downturn was acute and widespread in the rubber industry can hardly be denied. During the first five months of 1958, the industry cut its total employment by 37,000. Beginning in May, simultaneously with the upturn in industrial production generally, the industry recalled some 20,000 workers. The expectation is that by mid-1959, employment will be back to normal again. Recovery in the industry set in simultaneously with the industrial output upturn, but it did not pick up speed until the beginning of full scale production of the 1959 automobile and truck models got underway in the fall of 1958.

Besides the steady increase in industrial production—the FRB index stood only three points under the all-time high in November, 1958—there were other reasons why rubber industry people were extremely optimistic about prospects for 1959.

These were:

(1) The pick-up in rubber goods sales really had zip in the last quarter of 1958.

(2) New uses for rubber, due to research on many diverse products, are being pushed vigorously in all sectors and heavy advertising and sales promotion may be expected in 1959.

(3) The outlook for automobile sales in 1959 is much brighter than it has been before, and the replacement market on tires looks like it will be bigger than ever.

World new rubber consumption was 2,980,000 long tons in 1955, 3,025,000 long tons in 1956, 3,140,000 long tons in 1957, and held steady in 1958. Rubber industry experts expect world consumption of new rubber in 1959 to rise above 3,250,000 long tons, reaching in this New Year the goal at which the industry was aiming a year ago.

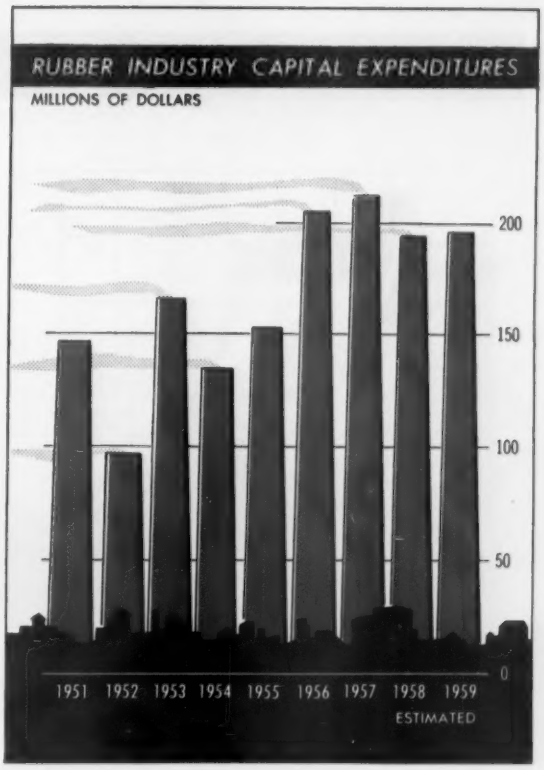
In the United States, according to the Statistical Committee of the Rubber Manufacturers Association and estimates made by the Rubber Branch, Chemical and Rubber Division, Business and Defense Services Administration, U. S. Department of Commerce, rubber consumption was estimated at about 1,350,000 long tons in 1958. This compared with 1,475,000 long tons consumed in 1957, 1,436,482 long tons in 1956, and 1,529,000 long tons in 1955, a record year.

The estimate for 1959 is close to a new peak in rubber consumption—jumping more than 10 per cent to 1,500,000 long tons. In 1958, synthetic rubber consumption stole a new march on natural rubber consumption, its ratio rising to 64.3 per cent, compared to 35.7 per cent for natural rubber. The estimate for 1959 is that of the 1,500,000 long tons to be used, roughly 1,000,000 will be synthetic and the remainder natural rubber.

World Rubber Supplies Expanding

The world supplies of new rubber are expanding rapidly. Rubber producers have announced expansion plans that will boost natural and synthetic rubber capacity from the 3,400,000 long tons available in 1957 to an estimated 4,400,000 long tons by 1962. This will be an increase of almost 30 per cent in five years.

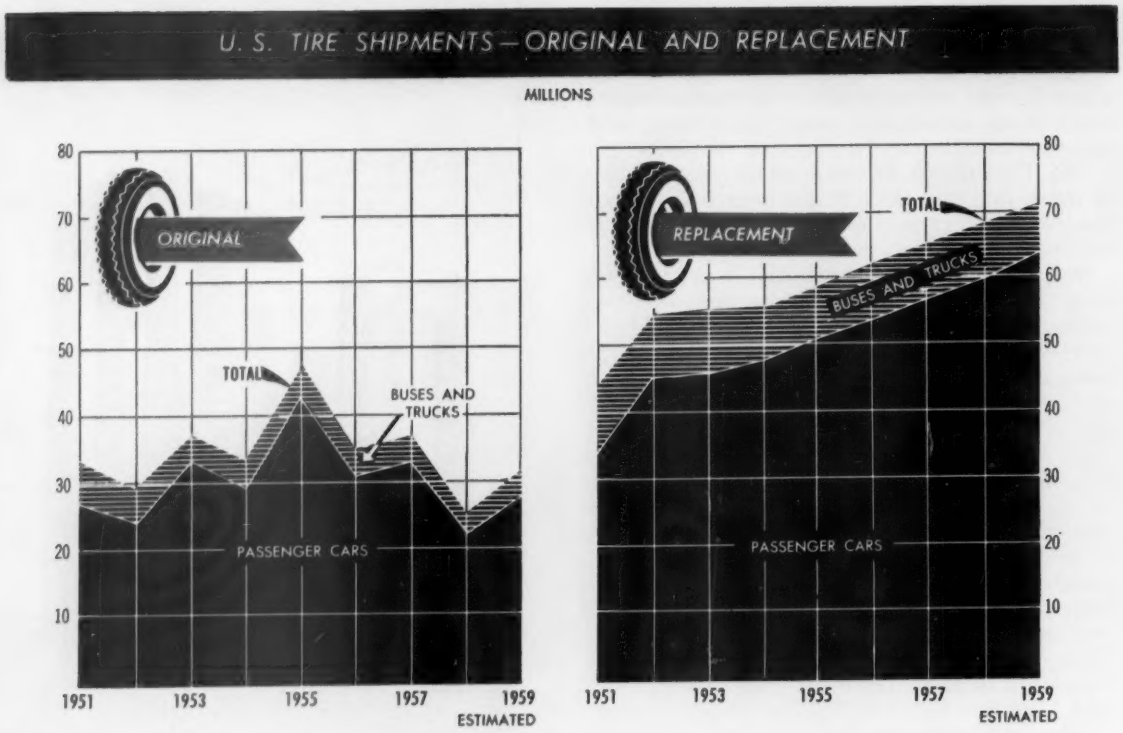
Synthetic rubber will account for virtually all of the increase in new world rubber supplies in the immediate future. However, important progress is being made by both governments and private producers in Malaya, Liberia and other nations in building natural rubber production on a sound economic basis. Efficient rubber producers will continue to be competitive with synthetic rubber producers, but because of the declining production in Indonesia, the world supply of natural rubber will not increase markedly in the future, although world consumption of rubber undoubtedly will set new records. Thus, the synthetic share of the



market seems certain to increase regularly. There is ample synthetic capacity, in existence and slated to be completed, to take care of all foreseeable demands, in the U. S. or anywhere else outside the Communist bloc countries.

The growth of synthetic rubber capacity in the Free World outside the U. S. has been, and is, growing rapidly. From 1955—when synthetic rubber factories were transferred from government to private ownership—through 1957, production capacity in the U. S. went to 1,600,000 tons, or a gain of almost 50 per cent in two years. New plans in other free nations now are accounting for most of the increase. An estimated 225,000 tons of synthetic rubber was produced in free nations outside the U. S. and by 1962, production capacity in these countries will have tripled.

The rubber industry in the U. S. faces a distinct challenge in one respect—that of its sharp declines in dollar profits and profit margins. Although the rubber industry has not been alone in experiencing profit downturns in 1958, profits in the first six months of the year were below the average for all manufacturing industries, whether measured as a per cent of sales or return on capital. There was some change in the last half, but management can be expected to be conservative in its budget planning until higher profit margins actually have become stabilized.



THE TRANSPORTATION SEGMENT

All factors point toward higher original equipment tire sales and a gain of at least 10 per cent in replacement tire sales over 1958.

► If the new 1959 model automobiles sell only 5,500,000 units—although many in the industry are predicting confidently that sales will top 6,000,000—the tire companies will sell roughly 27,500,000 new tires for original equipment in 1959. This will be up markedly from 1958, when only 4,300,000 cars were produced, using 21,500,000 tires for original equipment.

Automobile production in 1957 was close to 6,200,000 units, down slightly from 1956 and far under the 1955 record-breaking year in automobile sales.

Motor vehicle registrations have reached close to 68,000,000 in the United States in 1958, because so many Americans have succeeded in "making do" with older cars and trucks. Also, in spite of the economic downturn that reached 14 per cent, travel by car, truck and bus never did fall more than 10 per cent, and on balance, at year-end, it came within five per cent of the record-breaking travel year of 1957.

It is safe to say that since 1948, motor vehicle travel has doubled in the United States. The average American now spends almost 10 per cent of his disposable income in operating and maintaining his car, or cars.

The replacement market may prove to be far larger in 1959 than it ever has been before—and it was a big market in 1958. There were some 58,500,000 tires sold to motorists for replacement purposes in 1958, and the estimate is that more than 60,000,000 will be sold for these purposes in 1959.

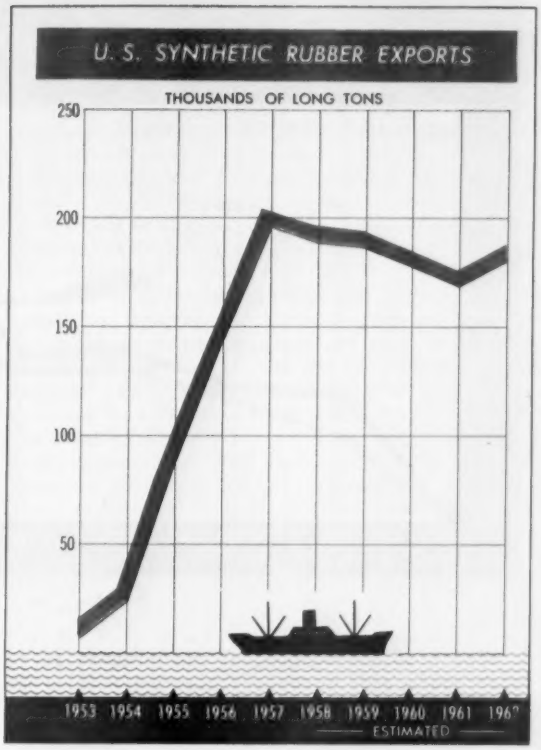
Tire company economists estimate that overall sales of tires, for all purposes, ran close to 100,000,000 units in 1958. They confidently expect tire sales to rise to 110,000,000 or 115,000,000 units in 1959. depending upon (1) how well the public "takes" to the new models; (2) how fast the total economy rises, and (3) how much new confidence the consumer gets in his own future.

It is safe to predict, on the basis of what has happened in the car market as the population has expanded, that there will be 69,000,000 motor vehicles on the road before the end of 1959. There was, for instance, a gain of 6.8 million households in the U. S. in the eight years from March, 1950, to March, 1958, according to the U. S. Bureau of the Census. Projected on a population chart, this indicates a gain of more than 800,000 households a year, and soon a mil-

lion a year. Since there are millions of youngsters who will be wanting cars, a gain of 1,000,000 a year in car and truck registration is not too sanguine a hope.

In 1957, the tire industry used 433,561,000 pounds of tread rubber. In 1958, based on three quarters' use of more than 330,000,000 pounds, it was estimated the industry would use 450,000,000 pounds of tread rubber. In 1959, observers confidently predict that the retreaders will use 475,000,000 pounds of tread rubber.

All in all, considering the strong showing replacements made in 1958, the cautious optimism of Detroit, based on initial reaction and sales of the new models, and the steady growth of motor vehicle registrations, plus the over-all economic picture, it seems clear that the transportation segment of the rubber industry faces a year of almost unparalleled opportunity and challenge. If the year turns out to be as strong economically as some believe, it is conceivable that 1959 will be mentioned in the future with 1955 as the two "biggest" years in tire history in this decade.



THE NON-TRANSPORTATION SEGMENT

A growing share of industry sales is foreseen for this phase of the rubber industry in 1959.

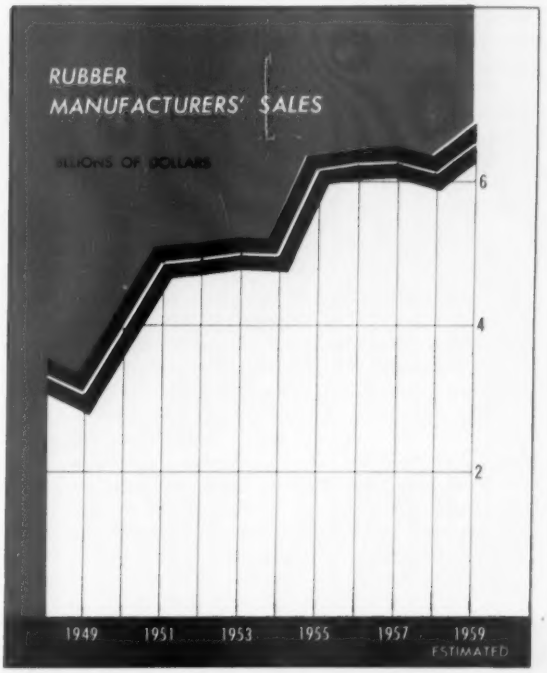
► The non-transportation segment of the rubber industry, which accounted for only 41 per cent of total sales in 1957 and climbed to more than 50 per cent of total industry sales in 1958, is expected to make another strong showing in 1959.

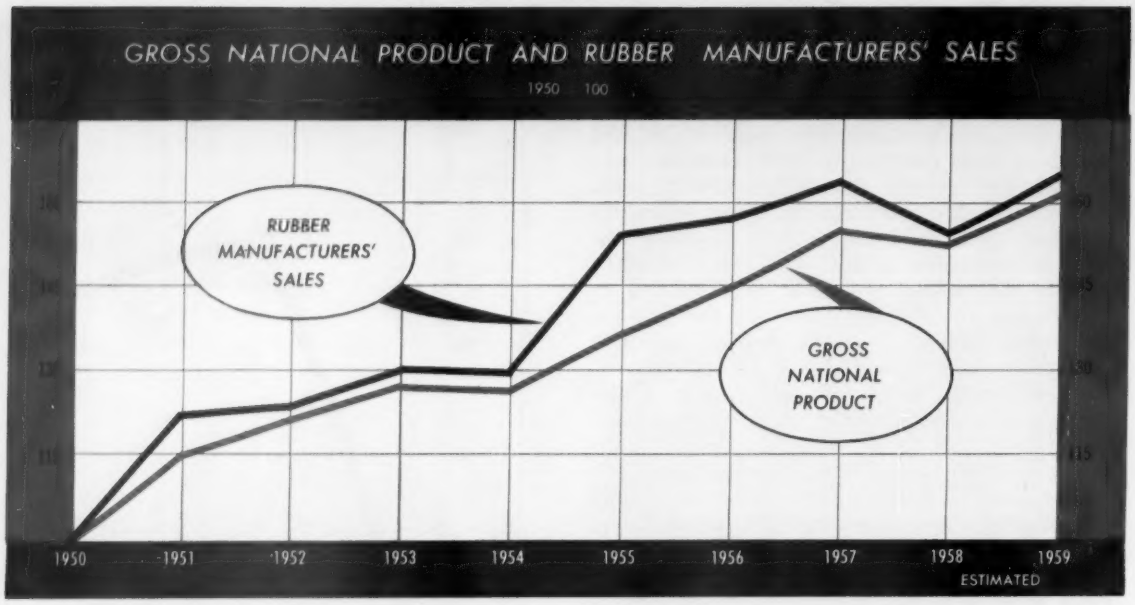
The dollar sales volume of non-tire rubber products, which long since became greater than the total dollar volume on tires, is expected to rise markedly in the New Year.

The producers of conveyor belting, foam rubber, hose, floor coverings, etc., are taking heart both from the steady increase in industrial production that has marked the economy in recent months, and from the similar increase in new home building. Those who specialize in goods for homes—such as floor coverings—have been looking, too, at the unparalleled rise in personal income, for the market for these products can become extremely large as consumers take on a more optimistic view of the future.

The mechanical goods producers, who have invested heavily in new plant and equipment in recent years, this year may cash in on their productive facilities. They were far less apprehensive about the future as 1959 approached than they had been a year before.

One producer notes that in the United States there are approximately 1,000 companies engaged in the manufacture and sale of non-tire rubber products. These manufacturers will consume about 560,000 long tons of rubber in 1959, 37 per cent of the country's total rubber consumption.





The non-tire segment of the industry in recent years has been growing faster than the tire segment as a result of the development of many new products and the increasing popular demand for standard products such as conveyor belting, foam rubber, industrial hose, rubber footwear and floor covering.

Non-tire rubber manufacturers should enjoy good sales in the overseas market as well as at home in 1959. This is particularly true of the producers of heavy industrial goods—conveyor belting and industrial hose, which are being shipped in increasing volume to the underdeveloped countries of Southeast Asia, South America and Africa.

Although the growth in sales in the non-tire segment has been most gratifying, the profit picture is disappointing. The intense competition for the available business frequently drives selling prices down to a point where it is impossible to make a fair return on investment. This problem became particularly acute in the 1957-58 recession.

The growth potential of the mechanical goods producers and the non-transportation segment seems to be greater, right now, than it has been in many years. The tip-off will come from the consumer himself, and it must be kept in mind that the consumer makes his decision in large measure both because of what Government does, or fails to do; because of what kinds of advertising he sees, or doesn't see, and because he is "sold," or not sold by the men in the business who have the most at stake in selling him. If the mechanical goods producers exercise as much ingenuity this year in promoting sales as they did in preparing for this open market, they may enjoy the greatest year in history.

Statements from the industry

We expect the domestic industry to consume about 1,500,000 long tons of new rubber in 1959. This should be the second highest level of use in the history of the industry, bettered only in 1955 when we consumed 1,529,699 long tons.

Ross R. Ormsby

Several segments of the rubber manufacturing industry enjoyed an exceptionally good year in 1958. This is particularly true among suppliers of several consumer-type end-products, such as replacement tires and rubber footwear.

It is certainly true that the effects of the economic setback in the first half of 1958 were felt by other segments of the industry, particularly among the makers of original equipment automotive products and manufacturers of many types of industrial rubber products. Rising production costs presented the industry with difficult problems that appear certain to carry over into 1959.

However, both production and shipment of rubber goods turned up in May and recovery since that time has taken place at a substantially accelerated pace. Generally, the industry expects continued improvement in 1959 with rubber consumption rising by as much as 13 percent over 1958.

Four types of replacement tires stood out as bright spots in 1958. Shipments of 59.5 million replacement passenger car tires, up 5 percent from 1957, set a new record. Shipments of replacement truck-bus tires were 3 percent ahead of 1957, and shipments of 3,575,000 farm tires represented an impressive 14 percent gain over the preceding year. Snow tire shipments also reached a new high in 1958 and it is significant to note that more than 27 million of these special purpose, high traction tires are now in use in the United States.

World rubber consumption is expected to increase as much or more in 1959 as it will in the United States. Our industry feels no concern about this, however, from the standpoint of raw materials. There is plenty of new rubber to go around, and as we see it, the excess of new rubber capacity over world requirements should continue at a level of about 600,000 long tons annually for some years to come.

Free world rubber producing capacity was increased by more than 350,000 L.T. in 1958 alone. Further planned expansions should increase the world's total new rubber producing capacity to more than 4,360,000 L.T. by 1962. Most of the new capacity will be in the form of synthetic rubber, of course, but after 1962 consumers will begin to feel the effects of forward looking programs initiated in some producing areas in the replanting of high yielding natural rubber stocks. The output of these plantings should further augment our supply.

We expect the domestic industry to consume about 1,500,000 long tons of new rubber in 1959. This would be the second highest level of use in the history of the industry, bettered only in 1955 when we consumed 1,529,699 L.T.

We are proud to report that the industry's ever expanding program of research and development continued to make itself felt not only in general product improvement but in the addition as well of many new items to the list of more than 40,000 end-products manufactured by the non-tire divisions of the industry. Notable among these were such items as new hose and belt and packing and seals, many of them specially designed to meet exacting performance requirements under extreme ranges in temperature.

Ross R. Ormsby

President, Rubber Manufacturers Association, Inc., New York, N. Y.

The rubber industry can look forward to improved sales of conveyor belts, hose, packing, power transmission belting and other industrial rubber products.

H. E. Humphreys, Jr.

Rubber industry sales in 1959 should set a new record of more than 6 billion dollars compared with an estimated 5.5 billion dollars in 1958. U. S. Rubber plans capital expenditures of approximately 30 million dollars in 1959 compared with 25 million dollars in 1958.

There are four principal reasons for this optimism: First, the industry faces a rising economy for 1959, a sharp contrast to the recession faced for 1958; Second, the market for replacement tires is growing; Third, there is a revival in demand from automotive manufacturers for the products which the industry makes for new cars; Fourth, markets are expanding for the industry's chemicals, plastics and other products.

Passenger car, truck and bus tire sales will total about 103 million units in 1959 compared with an estimated 94 million units in 1958. Of this total approximately 90 million passenger car tires will be sold compared with 82 million in 1958. Truck and bus tire sales will total about 13 million units next year compared with 12 million for 1958.

Replacement passenger tire sales should set a new record of approximately 61 million units compared

with 59.5 million in 1958. Original equipment tire sales will depend upon new car production next year, which is almost certain to total 5 million units and could be substantially higher.

The automotive industry buys approximately 12 per cent of the rubber industry's output and that renewed automotive demand will boost sales not only of tires but many other rubber industry products which go into new cars such as foam rubber, mats, windlace, hose, plastic-coated and other fabrics for upholstery, and a growing number of plastic items for interior trim.

Sales of industrial rubber products follow closely the Federal Reserve Board Index of industrial production and industry's capital expenditures. With increases forecast in both of these categories, the rubber industry can look forward to improved sales of conveyor belts, hose, packing, power transmission belting and other industrial rubber products.

Rubber consumption by American companies in 1959 will total better than 1.5 million tons, very close to the industry's all-time high of 1.53 million tons reached in 1955. An estimated 1.35 million tons were consumed in 1958. About 65 per cent of domestic rubber consumption in 1959 will be synthetic while the remaining 35 per cent will be natural.

Synthetic rubber consumption is rising rapidly abroad. Approximately 380,000 tons were consumed by free foreign countries in 1958. This figure can be expected to rise to more than 500,000 tons in 1959, or about 28 per cent of total free foreign consumption.

Much of the foreign increase is due to expanding foreign synthetic rubber production capacity. Italian, English and German plants came into operation late this year and French and Japanese plants are scheduled to start production in 1959.

H. E. Humphreys, Jr.

Chairman, U. S. Rubber Co., New York, N. Y.

Cooperation between rubber and textile research people is expected to expand new markets for rubberized products, consuming larger yardages of fabrics.

Charles F. Thomas

The future demand for textiles by the rubber industry has seldom been as difficult to forecast as it is today. There are, however, a number of optimistic signs.

As everyone is aware, we passed through the worst stages of a somewhat depressed condition during 1958. Since the demand for textile-based rubber products during the present year is most certain to pick up, so too should the demand for textiles.

There has also been a considerable increase in the usage of synthetic fiber fabrics for the manufacture of mechanical rubber products, and this trend, too, should continue. There are signs, in fact, that it will grow not only in volume but in variety as well during the coming year. The growing variety of new textile products available to the rubber industry is one of the bases for this prediction.

The increase in textile usage can also be expected to stabilize market prices. This will provide textile mills with the necessary incentive to continue their intensive research and development programs. Indeed, the result of past research is already bearing fruit in certain areas. Considerable changes can be expected, for instance, in segments of the reinforced rubber products trade which utilize textile products. As in the past, cooperation between rubber and textile research people is expected to expand new markets for rubberized products, consuming larger yardages of fabrics.

In another area, there is a real possibility that chafer fabrics which have been in an experimental stage for the past several years may be radically changed. If such is the case, it would result in an opportunity for the textile industry to increase its volume of business with the rubber trade.

Charles F. Thomas

Vice-President, Turner Halsey Co., New York, N. Y.

I fail to share the forecasters' unlimited optimism in regard to the rubber molded, extruded and cut washer goods industry.

R. A. Podoloff

The forecasts of the professional, industrial and financial analysists appearing in the press, are all looking to a strong last quarter for 1958, carrying over into a boom in 1959, with greatly increased consumer spending, increased industrial production across the board, and high stock market levels. Some even go as far as to predict that deflationary measures may be necessary in the last half of 1959 to slow down the forthcoming boom.

While I recognize this trend that increased production and consumer spending will be reflected all along the line, I fail to share the forecasters' unlimited optimism in regard to the rubber molded, extruded and cut washer goods industry.

If total national production figures could be compiled, I feel that they would show that less than 70 per cent of available capacity was utilized in 1958. Increased cost of labor and materials, which could not be passed on, plus lower sales volume, have shown their effects on profits in 1958.

Alert manufacturers have been exploring every means to cut costs and in many cases have turned to new equipment and more economical processes plus more efficient layouts of their plants. This upgrading of plants has released a good quantity of effec-

tive equipment on the market. Newly formed companies, as well as the smaller older ones, have absorbed most of this equipment to the end that we have had an increase in our national capacity in a poor 1958.

Most of the forecasters define the coming boom in terms of a 5 to 10 per cent increase in all industries. For our industry an increase of 5 to 10 per cent in capacity will not spell out a boom or show much of an increase in profits. It will be necessary for the alert companies to improve on the predicted 5 to 10 per cent increase in over-all production, to explore and develop new lines and improve on present lines. It will be necessary to put to greater use the new synthetic polymers in developing new and better end products.

It is my opinion that the rubber molded, extruded and cut washer industry will not feel the boom until 85 per cent of its capacity is reached and that I cannot see in 1959.

R. A. Podoloff

President, Bond Rubber Corp., Derby, Conn.

For 1959 the upturn in general business conditions, particularly in the automotive trade, seems to justify a predicted consumption of at least 270,000 long tons of reclaimed rubber.

C. H. Peterson

The consumption of reclaimed rubber during the past year followed the declining trend of our national economy. However, certain marks of stability were noted that augur well for the future of this special elastomer. Even though both natural and synthetic rubbers were in generous oversupply for the past twelve months, neither could economically displace reclaimed rubber in many areas of rubber goods manufacture. Under pressure that can be wrought only by competition, rubber technologists seemed to rediscover that reclaimed rubber is not only a source of rubber hydrocarbon but a process aid as well.

Generally speaking, reclaimed rubber offers both economy and quality to many rubber products. In addition, some of its singular properties, notably that it remains structurally stable at elevated temperatures tend to show that it can be used in other fields as a compounding material of significance. That reclaimed rubber remains unique in its rubber classification firmly establishes its future and undoubtedly prompted the action of most of the major reclaiming companies in reinvesting large amounts of capital in their operations over the past two years.

In 1957 the industry-sponsored Rubber Reclaimers Association instituted an educational program designed to foster a better understanding of the proper use of reclaimed rubber. During 1958 the program gained momentum under the guidance of an appointed educational committee and panel discussions were held before several technical society meetings. In 1959 the same panel forum will be available, as will a lecturer's service, for such interested groups as colleges, technical societies, and customer employee groups.

By the end of 1958, the consumption of reclaimed rubber in the United States will approach a final figure of 246,000 long tons or 18 per cent of all the new rubber used. For 1959 the upturn in general business conditions, particularly in the automotive trade, seems to justify a predicted consumption of at least 270,000 long tons for the year. With this prediction the reclaiming companies realize their product has been a significant factor in the economic stability of the rubber industry, and will continue, I am sure, the traditional philosophy of anticipating and meeting the demands of the expanding elastomer industry.

C. H. Peterson

President, U. S. Rubber Reclaiming Co., Buffalo, N. Y.

The carbon black industry anticipates a gain of some six to eight per cent in consumption in 1959.

R. W. French

The carbon black outlook for 1959 looks encouraging—particularly in comparison with 1958 when the industry suffered a decline of approximately 10 per cent from the 1,798 million pounds produced in 1957. One key indication—improved sales the second half of 1958—lends support to the more optimistic anticipation of the carbon black industry toward a gain of some 6 to 8 per cent in consumption during the coming year consonant with forecasts of the rubber industry. These have been published recently by various leaders of the rubber manufacturing industry and range from 7 to 14 per cent gain for the year ahead over last year.

The erection of additional overseas carbon black plants continued in 1958, with no change in this trend toward local manufacture in countries promising economically profitable markets. No reason appears to expect any reversal of this rising foreign manufacture of carbon black with its adverse effects on United States exports.

Some of the foregoing trends coupled with further unrecovered rising costs of raw material and labor witnessed even in the "recession" year of 1958 combined with the carbon black industry's excess productive capacity again narrowed the realization margin on this low-cost component of manufactured rubber goods. Nevertheless, the industry continued its achievements in the remaining fields of technological advance and business efficiency that have

kept the cost of this basic material from advancing in recent years relative to other raw materials and compounds consumed by the rubber industry. As one startling example, the price today of one of the most widely used types of carbon black is *lower* than it was ten years ago!

One of the current important contributions to the rubber industry is the cooperative effort of carbon black manufacturers in establishing fixed standards or specifications for various type carbon blacks to improve even further consistent quality and interchangeability.

As in the past, United Carbon Company is an active participant in such advances toward better products. To provide even further assurance of continually higher standards of quality, service and efficient manufacture for the rubber industry, United Carbon Company is doubling its research and development effort, personnel and expenditures following the establishment of plans and organization for a new technical service center in Akron to serve the world-wide needs of its present and future customers.

Despite the setback in car and tire sales during 1958, the youthful black masterbatch business pioneered by United's wholly-owned subsidiary, United Rubber & Chemical Company, made surprising gains. The United States raised its 1957 production of 87,700 tons to an estimated 130,000 tons in 1958 and there is no reason this industry-wide trend should not continue. United will continue to emphasize consistent, statistically-controlled quality for its Baytown Masterbatches while expanding its leading work in research and development toward ever better accommodation of the rubber industry's needs, whether these may be for increasing wear, greater cracking resistance, easier mixing and faster processing or special packaging and delivery arrangements.

Compared with 1958 the new year holds real promise, and in spite of the current challenges recognized above, the long range view looks even more encouraging to us.

R. W. French

President, United Carbon Co., Charleston, West Va.

It is reasonable to expect that 1959 will be the best sales year in the history of the rubber industry.

Harvey S. Firestone, Jr.

1959 should be the best sales year in the history of the rubber industry. I base this forecast on the continuing growth of unit tire sales, increased sales of all other divisions in the rubber industry and the encouraging rate of expansion of foreign operations.

There was a rising dollar volume in the industry during the last six months of 1958, and the rubber industry enters the new year with all factors favoring a continuing increase in dollar volume. The demand for tires in the year ahead will be greater because of increased production of automotive vehicles and a greater number of cars in use.

It is estimated that passenger car production will be up approximately 1,250,000 units, from 4,250,000 in 1958 to 5,500,000 in 1959, and that truck production will rise some 220,000 units.

The market for replacement tire sales through local tire dealers on some 43,000,000 cars that are now two years old or older presents another outstanding opportunity for 1959.

As for foreign operations, the rate of growth is exceeding that at home. Figures for rubber consumption outside the United States indicate an increase of 94 per cent in the past ten years. Rubber consumption in the United States has gained 42 per cent in the same period.

It is reasonable to expect that 1959 will be the best sales year in the history of the rubber industry.

Harvey S. Firestone, Jr.

Chairman and Chief Executive Officer, Firestone Tire & Rubber Co., Akron, Ohio.

In 1959 we expect increased consumption of natural in the United States as well as in total world use with the United States at about 520,000 long tons and the world figure at 1,970,000 long tons.

H. C. Bugbee

Although natural rubber usage in 1958 shared in the consumption reduction experienced in all rubbers in the U.S.A., total world consumption of natural showed an increase over the previous year. In 1959 we expect increased consumption of natural in the U.S. as well as in total world use with the U.S. at about 520,000 tons and the world figure at 1,970,000 tons.

Malaya, among the larger natural rubber producing nations of the world, is doing a particularly outstanding job in increasing output. By the end of 1958 it is estimated that 1,440,000 acres out of a total of 3,500,000 acres will have been replanted with high yielding trees. This proportion of high yielding rubber (over 1,000 lbs. per acre per year yield compared with present average of less than 500 lbs.) is presently being increased at the rate of over 150,000 acres per year. Yearly production in Malaya has risen from 575,000 tons in 1953 to 660,000 tons in 1958, still too early to fully reflect the over-all replanting scheme instituted in 1953 for the smallholder; however conservative estimates place Malayan production for 1965 at 850,000 to 900,000 tons.

In the meantime, Malaya's research and development effort is being enlarged and intensified. Sir

Geoffrey Fletcher Clay, a prominent agricultural expert, has recently been appointed to head up and coordinate this effort aimed toward lower costs and improved product. In February of 1958 Malaya increased its research and development funds by 50%. The additional sum will be used to greatly increase agricultural and applied research. The Rubber Research Institute will concentrate its efforts on still further increasing the amount of rubber produced per tree; the producers' research facilities in Welwyn Garden City, England, will also intensify efforts in the areas of fundamental and applied research.

It is conceivable that in the years to come research will provide natural with areas of use that will extend its scope considerably beyond such limitations as obtain today.

H. C. Bugbee

President, Natural Rubber Bureau, Washington, D. C.

I should expect . . . a further small but definite expansion . . . for the British rubber industry as a whole.

Stuart C. Covell

Twelve months ago, faced with every indication of a mild but definite American recession, I predicted a certain amount of expansion for the British rubber industry. In the event, the modest optimism I showed at that time is seen to have been justified. Admittedly the expansion, as far as it can at present be estimated, falls a good deal short of rapid growth; but it has been achieved in spite of a 12% decline in the production of rubber footwear directly attributable to competition from Hong Kong, where wages are low, hours long, and conditions notoriously below European standards. But because Hong Kong is part of the British Commonwealth and of strategic importance in the cold war, no adequate protection can be obtained.

Production of belting, on the other hand, has increased by nearly 17%. To some extent this reflects the increasing mechanization of British industry, with a consequent growth in the demand for conveyor belting, and for V-belts to replace the old power-shaft systems. To some extent also it stems from a marked increase in exports of rubber conveyors to the Continent.

The year 1959 is full of imponderables: including the probability of a general election, and the unlikelihood of any quick results from the long drawn-out negotiations for a Free Trade Area in Western Europe. Nevertheless, provided nothing very startling occurs in the international field, and the British motor industry retains its initiative, I should expect last year's results to be substantially repeated, and a further small but definite expansion registered for the British rubber industry as a whole.

Meanwhile a marked trend has already developed towards the increased use of synthetic rubber in Great Britain—particularly SBR. This coincides with the opening last summer of the first large-scale plant for the production of SBR in the United Kingdom—the International Rubber Company's plant at Fawley near Southampton. There is little doubt that domestic production will stimulate the use of SBR in general rubber goods.

At the same time, the Federation of British Rubber and Allied Manufacturers has been pressing forward with its efforts to regularize the marketing of natural rubber and to narrow the gap between type samples and description on the one hand and deliveries on the other. A booklet published by the Federation last year on Natural Rubber Grades and Contracts had a wide circulation both in the United Kingdom and the Continent. Its effect is already being felt in the standard of natural rubber shipments reaching the London market, and manufacturers are hopeful that this improvement though necessarily slow, will be continuous and progressive.

Stuart C. Covell

Director, Federation of British Rubber and Allied Manufacturers, London, England.

The industry will consume 1,500,000 long tons of rubber, bettering 1957 and 1958 totals.

J. W. Keener

The American rubber industry will bounce out of its 1958 dip and resume its long-term growth pattern through 1959. The United States will consume about 1,500,000 long tons of new rubber in 1959, compared with the estimated consumption of 1,350,000 long tons in 1958 and 1,465,000 long tons in 1957.

I believe the rubber industry could well run a little ahead of the rest of the nation's economy in 1959. I base this upon the upturn in industrial rubber, the rebuilding of still-depleted customer inventories, substantially greater production of new automobiles, and continuing strength in replacement tire sales.

Of the new rubber consumed in the United States in 1958, about 64.2 per cent was domestically produced man-made rubber, compared with 63.2 per cent in 1957. This marked the fourth successive year in which the ratio of use of synthetic rubber has increased. Total tire shipments in 1959 are expected to be about 10 per cent above last year and this would mean sales of about 113 million tires of all types. More than one half of these will be tubeless tires, a B. F. Goodrich innovation of ten years ago. Passenger car replacement tire sales in 1958 ex-

ceeded 60 million units, about 6½ per cent more than 1957, and truck replacement tire sales totaled 8.8 million, about 3.3 per cent more than 1957. Farm tire shipments were up 13 per cent over 1957.

World consumption of rubber in 1959 may set a new record of about 3,300,000 long tons, excluding synthetic rubber consumed behind the Iron Curtain, against comparable estimated consumption of 3,130,000 long tons, in 1958. Rising consumption in the free world outside the United States and a sharp increase in natural rubber imports by the Soviet bloc countries largely offset the decline in United States new rubber requirements in 1958. Soviet bloc imports of natural rubber are estimated at 350,000 long tons in 1958, about 20 per cent more than the 1957 total.

World production of natural rubber is expected to reach 1,885,000 long tons in 1958, in line with the amount of natural rubber that will be consumed this year. Meanwhile, United States capacity for production of man-made rubber will increase to nearly 1,700,000 long tons by the end of 1959. This compares with 1,372,000 long tons of capacity at the end of 1957, the expansion in two years exceeding 22 per cent.

J. W. Keener

President, B. F. Goodrich Co., Akron, Ohio.

We should be able to generate an income dollar that will do more than barely recover costs. The pressure on management will certainly be to produce better profits.

Norman J. Johnson

At this time of the year we reflect on what has taken place in our industry during the past year. This is undoubtedly the best way to attempt a forecast of what might be in store for us during 1959. The many published earnings reports I have read during the past year—and those of other industries as well as our own—reveal a marked decline in sales, particularly in the first half of the year. The resultant decline in earnings, however, has been too pronounced.

Perhaps many of us have taken business with the foremost thought in mind of keeping intact an efficient working force and keeping equipment busy, with the inevitable result that the income dollar just barely matched costs, and in some instances failed to do so. It is encouraging, however, to note most recent reports show a trend upward in both sales and earnings, which it is hoped will carry into and throughout 1959.

It is predicted that business capital expenditures, inventory requirements, housing, consumer buying, and government spending (federal, state and local) during 1959 will increase approximately $34 billion over 1958. This increase of $34 billion in the gross national product will steadily absorb unused resources of plant and labor, and toward the end of 1959 should push operations to capacity levels.

Now it is only fair for us in the rubber segment to expect an increased demand for our products and services in the coming year. Therefore, if we all use good judgment and honest salesmanship, we should be able to generate an income dollar that will do more than barely recover costs. The pressure on management will certainly be to produce better profits.

We all share in one assurance for the coming year. God willing, 1959 will give us 365 days of 24 hours each—all tax free. We could ask for nothing better!

Norman J. Johnson

President, Griffith Rubber Mills, Portland, Ore.

Outlook for 1959 latex consumption indicates the first half will greatly exceed that for the same period of 1958.

Arthur Nolan

The total quantity of all rubber latices consumed in the U.S.A. declined about 5% during 1958 as compared with 1957. All the decline occurred with Hevea (down about 4%), and S-Types (down about 10%). Neoprene and N-Types held level or improved over 1957. Outlook for 1959 consumption indicates at least the first half will greatly exceed that for the same period of 1958.

Prices for Hevea were distressed during most of the year and ranged between 30 and 38¢. Lower priced S-Types were offered during the year with no noticeable change-over to such lower priced grades in the major areas of consumption. Otherwise regular S-Type prices remained substantially unchanged.

Supply of Hevea during early 1959 will probably not be in balance with demand. S-Types, which will be in good supply, will probably fill the deficit. It is likely, during 1959, that S-Types will increase their percentage of foam use by reason of price, availability and technological advances.

Progress in N-Type latices appears to be a bright spot, with slightly more being used during 1958 than heretofore, in spite of generally lower economic activities. New uses appear to be gaining and older uses continue to expand.

Whereas rubber latice's growth rate is slowing, that of plastic latices continues to increase at a faster rate. New and increased uses in paints, coatings, adhesives and textile applications continue.

Arthur Nolan

Vice-President, Latex & Rubber, Inc., Baltimore, Md.

The dealer trade acts as a catalyst in bringing into the market the grades of rubber which, from long study and experience, it knows will meet the consumption requirements of the American industry.

R. D. Young

Since other contributors to this special edition of RUBBER AGE will undoubtedly deal with industry forecasts for 1959, the supply and demand situation, and technical matters, the writer will confine his comments to the position occupied by this Association in, and its contributions to, the rubber industry.

The Rubber Trade Association of New York, Inc., is basically a servicing organization, and its members can best be described as international rubber merchants who, over a long period of years, have constituted an important segment of the rubber industry. The membership of the Association consists of dealers, brokers, and agents of foreign suppliers interested in the importation of natural rubber from many parts of the world.

Every year a high percentage of the half million tons of natural rubber imported into this country moves through this well-organized channel, which originates in the sources of supply and flows through the trade to the rubber manufacturing industry in the United States. In order to efficiently perform this function, the importer must secure natural rubber from many and varied sources of supply in producing countries, and assume all financial responsibility and risk in connection therewith, from the date of shipment to the time of delivery to the American consumer.

Assuming that the percentage use of synthetic rubber in this country has reached its maximum under present technological conditions, the total tonnage of natural rubber handled by the members of this Association should increase as total rubber consumption rises in the years ahead. Like other suppliers of raw materials to manufacturing industries, the dealer members of the trade offer an irreplaceable service.

Unlike some other raw materials, however, natural rubber fluctuates in value from hour to hour, following closely the changes in the supply and demand position of this essential material throughout the world. The well-established rubber market in New York maintained by the dealer members of the trade insures the rubber manufacturing industry of a ready source of supply for all types and grades of natural rubber, at competitive world prices.

In contrast with the financing costs and risks borne by manufacturers on purchases of natural rubber direct from foreign markets, the purchaser from the New York dealer enjoys liberal credit terms at prices often lower than those existing in primary markets. In addition thereto, the manufacturer is assured of a delivery of the type of rubber which it can use at time of actual need, thereby eliminating expensive warehousing costs and the maintenance of an unnecessary inventory.

The dealer trade acts as a catalyst in bringing into the market the grades of rubber which, from long study and experience, it knows will meet the consumption requirements of the American industry. This expert knowledge of individual requirements has been acquired only through long years of servicing the manufacturing industry. Many of the dealer firms have been in existence for almost half a century, and have achieved a record of dependability and financial responsibility which is of great importance and continuing benefit to the consumer.

In summary, the dealer members of the Rubber Trade Association of New York, Inc., day in and day out offer the following services to the widespread rubber manufacturing industry:

(1) A consistent and dependable source of supply of all varieties of natural rubber, for almost any delivery period, at a reasonable price.

(2) Aid in financing the raw material, through the extension of credit, at least until it is well on its way to a finished product.

(3) The maintenance of an adequate pipeline of natural rubber in transit from primary markets to ports of entry in the United States favorable to the location of the manufacturer, and the assurance that, as sources of supply develop in new areas of the world, this additional production will be made available.

(4) The benefits of long experience by skillful, dependable and sound financial organizations in satisfying the requirements of the American rubber manufacturing industry.

R. D. Young

President, Rubber Trade Association of New York, Inc., New York, N. Y.

There is every reason to predict gains for all of our basic industries. For the companies that have planned well, the year 1959 will be a good one.

William O'Neil

Accelerated by a tremendous final fiscal quarter in 1958, the rubber industry outlook for 1959, like most of the other major industries in the nation, is very promising.

Few quarters in the history of the General Tire & Rubber Co. compare with the final three months of 1958, and we project vigorous business for all our divisions in the New Year ahead. After a slow start, the end result for business in 1958 was satisfactory, and we are confident that 1959 will be a good year for our company, the rubber industry, and the nation.

The future in the rubber business appears especially expansive. The replacement tire demand in 1958 hit the expected record total . . . and there

are indications that this rising demand will continue in 1959, and for years to come. If the automotive industry rebounds as expected, our industry faces the biggest production demand it has ever known.

Total production figure for the industry has been set at 111 million units in 1959. This figure could well be on the conservative side. From General Tire's point of view, we have just completed one of our finest tire sales years . . . and we, too, agree that the outlook is extremely promising.

To best illustrate General Tire's plans to meet the growing demand, the company's board of directors recently authorized the construction in 1959 of a third tire-building plant. Site of the new factory, a multi-million dollar investment, will be announced in the immediate future.

Vehicle travel on the nation's highways is increasing daily. The nation's 100-billion dollar highway program is now moving along encouragingly, and this road-building progress will reflect in greater demands for tires.

Few people realize it but American motorists today are paying less for tire mileage than they did 25 years ago. What other commodity costs less? The quality of product is a tribute to our ceaseless search for better materials, better engineering and better workmanship.

Our overall outlook is bright. All facets of the nation's economy have turned upward . . . and there is every reason to predict gains for all of our basic industries. For the companies that have planned well, the year 1959 will be a good one.

William O'Neil

President, General Tire & Rubber Co., Akron, Ohio.

The retreading industry, growing tremendously over the last several years, will continue to climb upward resulting in sizable increases in tread rubber production.

T. C. Johnson

The Mohawk Rubber Company enjoyed a banner year in 1958, with sales and profits reaching an all-time high. Our modern plant in Helena, Arkansas, in the heart of the rapidly expanding South and Southwest contributed immeasurably, as did our new plant in Stockton, California, that affords us nationwide distribution. 1959 appears to offer even greater opportunities to the rubber industry than last year. With the national road building programs now underway, more cars will be traveling further. Multiple-car ownership continues to increase and people are keeping their cars longer.

As an independent manufacturer, serving the replacement tire market, Mohawk is vitally interested in the approximately 2 million unit replacement tire increase anticipated for 1959. Truck tire sales should certainly be up again in 1959, in view of the progress made by the trucking industry.

The retreading industry, growing tremendously over the last several years will continue to climb upward, resulting in sizable increases in tread rubber production. Tire casings are lasting longer making it economically feasible to retread, particularly so in the trucking field.

The advances made by the chemical and cord processors and equipment manufacturers enable the rubber industry to constantly improve the finished product, through efficient cost-saving operations.

We at Mohawk, look to 1959 with optimism, and anticipate that our growth will be in direct proportion to the vast potential in the offing.

T. C. Johnson

General Sales Manager, Mohawk Rubber Co., Akron, Ohio.

We are expecting the total volume of mechanical rubber goods business to be 3 per cent more in 1959 than in 1958.

Miles J. Smith

The past year brought a pleasant surprise to many of us in the rubber industry who had expected the recession to develop deeper and last longer. To be sure, 1958 has not been a banner year by any standard, but neither has it proved the worst year. The inventory reduction which customers were accomplishing in early 1958 slowed down about June 1st and since then orders for mechanical rubber goods have been increasing steadily. The last quarter of 1958 finds most manufacturers with a satisfactory order backlog.

As for the year 1959, we expect a continuation of the present tempo of business, or perhaps a further small volume increase to extend through the first half of 1959. During the third quarter of 1959 we may have a bottoming out of the advance and a possible slight decline as the inventory buildup is completed. This prediction, of course, must assume no change in the military situation which might take us from a cold to a hot war.

One chief concern of a rubber manufacturer in 1959 will be in getting his higher costs into his product. Recent increases in labor costs and materials must eventually be put into selling prices, which will be difficult in face of present competition.

In the past some of these extra costs have been offset by utilizing cost cutting methods, which now have been fully explored. While some improvements will, of course, be made we can not expect advances to keep pace with those of the past decade. We will, therefore, have more difficulty maintaining a satisfactory margin of profit in 1959.

During the early months of 1958 many rubber companies cut overhead expenses which not only helped them through the recession but should put them in a better position profit-wise during 1959, provided a satisfactory volume of business is available. We are expecting the total volume of mechanical rubber goods business to be 3 per cent more in 1959 than in 1958.

Our company's experience lately is one of increasing the total orders shipped on the same volume of business because customers have ordered in smaller quantities this year. Perhaps this was the result of an effort to reduce inventories which required more fill-in orders. Of course, the handling of the extra work results in higher costs.

For the year ahead we would expect an increase of small proportions in the percentage of synthetic rubber usage at prices at or near present levels. Crude rubber prices should be held in line by competition from synthetics, which we find are improving in quality.

To sum up, we are moderately optimistic for 1959 but believe business will be hard fought for and, therefore, profits will come to those who can master the art of keeping costs down.

Miles J. Smith

President, Carolina Rubber Hose Co., Salisbury, N. C.

The synthetic rubber industry . . . in its short span under private ownership has increased capacity by 50 per cent and by 1965 we will be realizing the full benefits of this increase.

A. K. Walton

Copolymer Rubber & Chemical Corporation has taken its place in the rubber industry as a responsible member of that community determined to do its share in the development and extension of man made rubber. The company has completed and dedicated during the past year a modern research facility, as well as additional pilot plant support for its research and development program. A steam and electric power plant has been built to further make Copolymer an integrated production facility, able to meet the demands that the foreseeable future will make on the company.

Emphasis is being given to quality production of present polymers, while still looking to the future in the search for the rubbers which we will be using in the years to come. A quick shift to high quality black masterbatch rubber production is evidence that Copolymer need not take a back seat in meeting the ever changing demands of the rubber industry.

The synthetic rubber industry of which Copolymer is a part, in its short span under private ownership, has increased synthetic rubber capacity by 50 per cent and by 1965, we will no doubt be realizing the full benefits of this increase. In the meantime, the cost of this expansion is having an effect on the earnings of the synthetic rubber plants and cannot be ignored. During 1958, the synthetic rubber industry has also experienced technological changes of serious consequence.

Black masterbatch rubbers have become an important segment of our business. In black masterbatch rubbers, as well as in other types, we are developing many specific polymers and are offering the customer a much larger choice of types than was available to him under government ownership. This tendency to become a "super market," offering the customer a wide range of specially designed rubbers, carries with it a requirement for increased dollar investments in inventories and shorter production runs as well as many other problems.

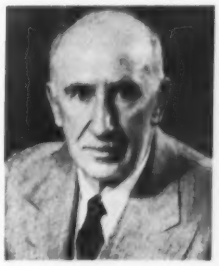
Notwithstanding the fact that the price on certain polymers has not changed, the rubber user is receiving the benefit of lower prices by the swing to oil and black masterbatch polymer combinations which are not as profitable as non-extended polymers and synthetic latices have experienced actual reductions in price. At the same time that price factors have been operating to reduce our margins, our cost of production has been influenced by increases in the cost of labor and materials.

Synthetic rubber has already claimed a vital phase in our national economy as well as a part of our national security program. We are only just out of reach of polymers which will be satisfactory as replacement for natural in truck tire production and natural latex in many latex uses. It is vitally important, not only to us within the industry, but to the nation as a whole, that we in our zeal to be competitive do not fail to retain an adequate margin to continue to exploit a myriad of opportunities for the development of still unheard of new and better products.

A. K. Walton

President, Copolymer Rubber & Chemical Corp., Baton Rouge, La.

1959 will be one of the best years ever and we in the chemical industry will continue to grow and prosper.



C. P. Hall

In reviewing the predictions for 1958, it looks as if some were a bit optimistic. With another New Year at its beginning, we have another chance to make mistakes by hoping that the National Budget will be less than 12 billion dollars in the red as it was in 1958. With a new Berlin crisis coming up in a few months, the new Congress is really something to take into consideration. We must also not overlook the trouble spots all over the world where we

can't give away enough to keep everyone at home working without paying for not producing.

All of the economists are predicting a bigger and better year for 1959 and I guess I'll have to go along with them—based on the fact that our last quarter sales were the highest in our forty-year history. I sincerely feel, though, that technological and scientific research and development will be the basis of our continued prosperity. We must develop new and better products—at lower costs. Otherwise, our overhead will surely catch up with us and our predictions will again go sour. We cannot keep on shortening working hours and raising wages without producing more per man hour than they can in other countries of the world—as may be demonstrated by the several hundred thousand automobiles coming into this country each year.

We are again, or still, faced with the French difficulty and will, no doubt, have to bail them out again with enough to keep them afloat as a world power. We continue to have to deal with the Middle East situation where every hand is ready to grab not only his share but ours. We cannot overlook the Far East where natural rubber is still important to our economy—but not vital as it once was. We must succeed in improving our relations with South and Central America—whose oil and minerals are so necessary to our welfare.

In summing up, I feel that business-wise 1959 will be one of the best years ever—and we in the rubber chemical industry will continue to grow and prosper. My only concern, therefore, is that, as a Nation, we just have to get some of the breaks of the game to be able to solve our problems to hold on to and improve our way of life.

C. P. Hall

President, C. P. Hall Co., Akron, Ohio.

With greater optimism felt in the automotive industry, it is expected that a good demand for scrap rubber will continue throughout the winter.

S. I. Freedman

Had this report on scrap rubber been written several months ago, it would indeed have been a very sad commentary on the activities of the scrap rubber industry for 1958.

The general recession took its toll in scrap rubber, not only price-wise but the volume of business done reached one of the lowest levels in the last twenty years.

Late September saw a somewhat healthier condition come into being and since that time there has been a steady though slight improvement in general conditions, and although price-wise the market has not shown any great betterment, there has been an increased demand for various types of scrap, and butyl tubes especially showed marked improvement.

Several grades of scrap at the present time are without doubt underpriced and tires especially come in this category.

With greater optimism felt in the automotive industry, it is expected that a good demand for scrap will continue throughout the winter.

Whereas carload freight rates on scrap rubber had increased during 1957, there have been some adjustments in scrap rubber rates which have extended the perimeter of operation. Further adjustments pending, if approved by the rail carriers, will do much to move scrap rubber from areas where presently there is no flow of tonnage.

The number of dealers who have been handling rubber for years is steadily diminishing and scrap tires today are in a great part still being accumulated by scrap tire manipulators whose prime interest is the selection of useable or recappable casings.

The general outlook for 1959 is much more promising than indications of a year ago.

S. I. Freedman

H. Muehlstein & Co., Inc., New York, N. Y.

As a result of the cost consciousness developed in 1958 we are optimistic, indeed, and fully expect that 1959 will be a record year in all respects.

W. D. Voit

For most of the rubber industry the first half of the year 1958 was a year of decreasing sales and profits, in line with the economic recession which affected nearly all industry. From this rather harrowing experience, however, much good has come. A thorough "soul searching" on the part of top management throughout the industry has without doubt resulted in elimination of much of the luxury overhead that many of us had come to feel was an integral part of the modern way of doing business. This sudden focus on the elimination of all unnecessary costs has unquestionably resulted in a much more efficient operational base from which our industry can look forward into 1959.

At Voit this past year, perhaps because of the segments of the rubber industry in which we are active, our experience ran somewhat counter to that of the industry over-all. In athletic and sporting goods items—in common with the experience of many consumer nondurable goods producers—demand for our products proved to be relatively recession resistant. More leisure time and increased youth population, I am sure were high on the list of factors responsible. Paralleling the experience of most industry, however, price levels have not kept pace with

inflationary cost increases, and competition is keener than ever.

Our activity in production of materials for retreading and repairing of tires, in common with the experience nationally in this segment of the rubber industry, showed in 1958 a continued growth in demand for our products. This business, of course, has always been one of close profit margins.

For 1959 I believe that both of these segments of the rubber industry will see continuing growth, and as a result of the cost consciousness developed in 1958 we are optimistic, indeed, and fully expect that 1959 will be a record year in all respects.

W. D. Voit

President, W. J. Boit Rubber Corp., Los Angeles, Calif.

In 1959 the rubber industry will have the highest dollar volume of sales in history.

E. J. Thomas

Forecasts indicate that in 1959 the rubber industry will have the highest dollar volume of sales in history, and the Goodyear Tire & Rubber Co. is planning a capital expenditure of $70,000,000 in 1959, $10,000,000 more than was spent in 1958.

This increased planned expenditure is evidence of our faith in the sound recovery of business in 1959. We believe that the part of our industry which was hit the hardest this year—the sale of tires and other rubber products to the automobile, truck and tractor manufacturers—will show considerable improvement. We believe they are going to need 25 to 30 per cent more of these products in 1959.

No big rise in prices is anticipated in 1959, although prices for some of the industry's products did erode too much in the recession period and need to be improved. Another important factor in the rubber industry is that of the total rubber now being consumed, close to 65 per cent is made of various synthetics, an indication of the wide improvement and development that has been made in this field.

I look for renewal passenger tire sales to reach 62,000,000 units, an increase of nearly two million over 1958's final figure.

For the industry as a whole, estimates for 1959 pneumatic tire production (including industrial pneumatics) are for at least 112 million units versus 102 million for 1958, and a total rubber consumption of 1,500,000 tons versus 1,345,000 tons this year.

E. J. Thomas

President, Goodyear Tire & Rubber Co., Akron, Ohio.

in the government's view

As the New Year begins, the over-all economy has regained the record high reached in mid-1957. The prospect is for further improvement. We entered 1958 with the economy in accelerated decline and with uncertainty and pessimism widespread. Recovery commenced in the Spring. Today, we start the New Year from a position of increasing strength and of growing confidence.

Although most economic indicators report progress, a few still lag. Automobile production, previously retarded by strikes and weak sales, looks more hopeful; the full test of the market should be in the Spring.

The decline in plant and equipment expenditures ended last Fall. The latest survey of intentions by businessmen for the first quarter of the New Year indicates firming tendencies but at an investment rate only slightly in advance of the final quarter of 1958.

Employment has increased above recession levels. From an unemployment figure of a little over 5 million, seasonally adjusted, in the month of April, we have seen a reduction to approximately 4 million by the year-end. However, with the number of unemployed still above normal, a prime objective in 1959 will be more work for more people.

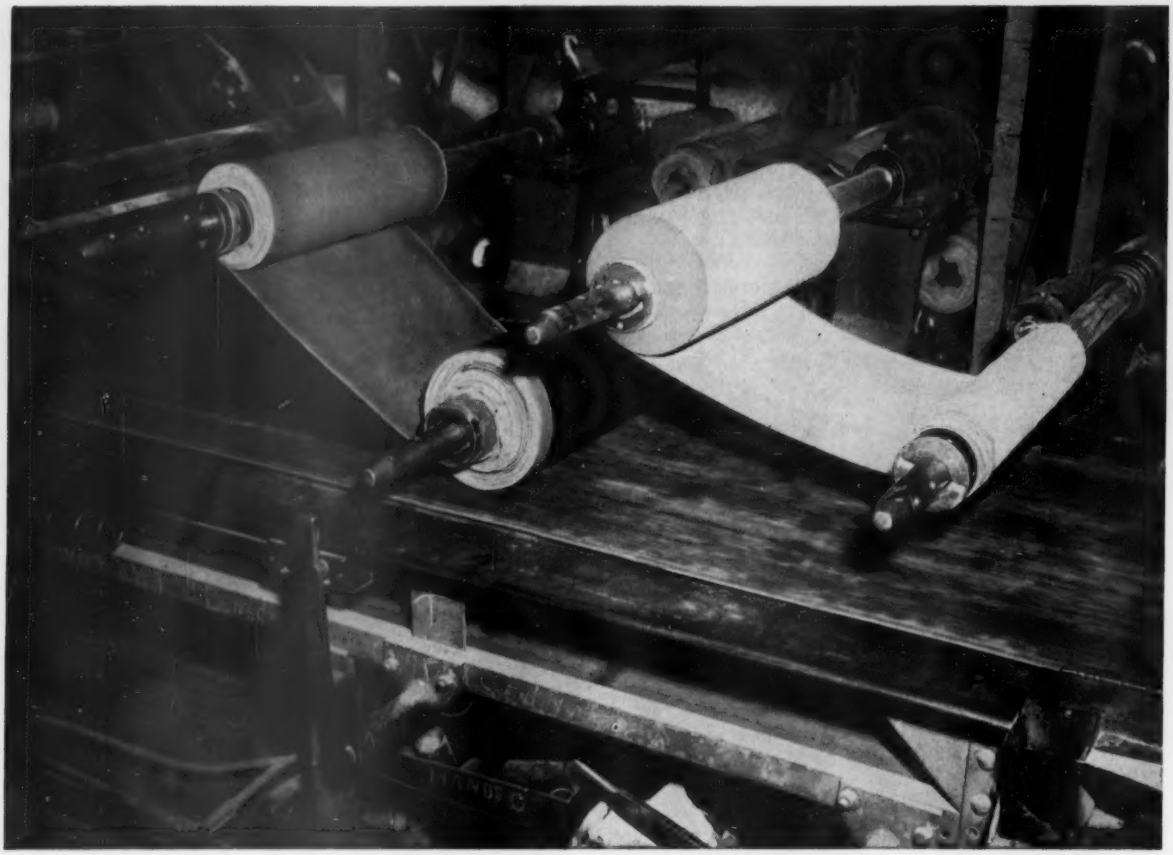
On the plus side, the total Gross National Product—the so-called "measurement of prosperity"—in the fourth quarter of 1958 broke all previous records in value and, after allowing for price rises, the physical volume of output is estimated to equal the peak attained in the Summer of 1957. The momentum continues.

The long range outlook also has an encouraging influence on the economy. The coming year will bring us to the threshold of the 1960-70 decade during which the impact of population increase and the continuing flood of invention and technological progress will provide unprecedented opportunities for capital investment and expanding employment and sales. These factors are part of the base for a prosperity which should surpass anything we have experienced.

Of course, the ascending curve will exhibit periodic pauses and fluctuations, but, barring war, and if we employ our dynamic free enterprise system effectively, the course will continue upward.

Lewis L. Strauss

Secretary of Commerce, U. S. Dept. of Commerce, Washington, D. C.



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RUBBER AGE

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GASOLINES vs. ELASTOMERS

Effects produced by highly aromatic gasolines on various polymers

By JOHN J. PRENDERGAST

Butyl Technical Service Laboratory, Thiokol Chemical Corp., Trenton, N. J.

SINCE 1953, the automotive industry has been developing higher engine compression ratios in the newer cars at an extremely rapid rate. From 1946 to 1953, ratios remained practically constant at about 7:1, but from 1953 to 1957 jumped to 9:1. Should this trend continue even at its present pace, the average compression ratio of new cars in 1960 will be 10:1, while those of the high performance cars may exceed 12:1 *(1)*.

To gain the power and efficiency provided by increased compression ratios, these future engines will require new high quality fuels of increased octane number. It is estimated that the predicted trend will necessitate a 10 to 15 octane number increase over the present premium grade gasolines of 95 to 100 octane number *(1)*.

While it is recognized that the refiners are faced with a difficult task in keeping pace with the automotive industry's continually changing demands, the immediate problem is primarily an economic one *(1, 3, 4)*. On the other hand, the manufacturers of mechanical rubber goods are quite concerned over the ultimate composition of these future fuels since the necessary changes may seriously curtail the performance of rubber compounds used in contact with them.

It is well known that gasoline is composed essentially of three types of hydrocarbons: paraffins, olefins, and aromatics. These components vary widely in the ratios in which they exist in the various commercial fuels. A survey conducted by the SAE Division of ASTM has revealed that the average of 12 premium grade samples gave the following analyses *(2)*:

	High	Low	Avg.
Octane Number	102.0	99.6	100.8
% Paraffins or Saturates	65.0	43.0	52.0
% Olefins	31.0	9.0	18.0
% Aromatics	42.0	8.0	30.0

Tests were run by the Thiokol Technical Service Laboratory on ten premium grade fuels purchased in the Trenton, New Jersey, area. However, since it is the aromatic component which is the most severe in degrading the commonly used elastomers, and therefore the principal concern of this study, values for this component only were obtained. Percentages ranging from 20 to 45 with an average of 33 gave reasonably close agreement with the ASTM results.

While the average ratio of aromatics seems not too alarming, it is significant that present values up to 45 per cent do exist. This would appear to substantiate to some degree the fact that one of the existing practical methods for raising the octane number of future fuels is to increase the ratio of the aromatic constituents *(3)*. Some of the major oil companies have ventured opinions that total aromatics in fuels of the near future may be as high as 65 per cent.

It is possible that the present pattern of wide variation in component ratios among competitive fuels will continue to exist. However, it is also probable that

the aromatic fraction of these fuels may necessarily remain more constant if used at high ratio levels. In any case, even if several grades of the same product are manufactured to handle specific levels of aromatics in new fuels, it still will be necessary to develop compounds for the most severe conditions.

It is, therefore, in anticipation of these new, and potentially highly aromatic fuels that this study was made to observe the suitability of the more commonly used oil-resistant elastomers for applications involving fuel contact.

Test Compounds and Fuels

Although there are a number of elastomers available which may be classified as oil-resistant, only those which are commonly associated with the ASTM designations SA, SB and SC were used in this work.

TABLE I—COMPOUND FORMULATIONS

Press cures: 40 min. @ 298°F.

Polysulfide FA	100.0
SRF Black	60.0
Zinc Oxide	10.0
Stearic Acid	1.0
MBTS	0.3
DPG	0.1
Polysulfide ST	100.0
SRF Black	60.0
Zinc Oxide	0.5
Stearic Acid	3.0
GMF	1.5
Neoprene WRT	100.0
Zinc Oxide	5.0
Ex-Lite MgO	4.0
Stearic Acid	1.0
Neozone A	2.0
Monex	0.5
DPG	0.5
Na-22	0.4
Sulfur	0.5

	Loading No. 1	Loading No. 2
SRF Black	65	—
MT Black	—	150
Butyl Oleate	10	20

Nitrile Rubber (as indicated)	100.0
Zinc Oxide	5.0
Stearic Acid	1.0
Neozone D	1.0
Monex	0.6
Sulfur	1.0

	Loading No. 1	Loading No. 2
SRF Black	75	—
MT Black	—	150
TP-95	10	20

Note: For the neoprene and nitrile rubber stocks, loading 1 refers to elastomers compounded to obtain approximately equal loading levels, and 2 to elastomers compounded to obtain approximately equal physical properties.

TABLE II—PER CENT VOLUME SWELL OF TEST ELASTOMERS IN TEST FUEL COMPONENTS AT ROOM TEMPERATURE

(1D = 1 day; 1W = 1 week; 1M = 1 month)

	ASTM #1 Isooctane			Comm. Fuel 25% arom.			Comm. Fuel 35% arom.			Comm. Fuel 45% arom.			Test Fuel 50% arom.			Test Fuel 60% arom.		
	1D	1W	1M	1D	1W	1M	1D	1W	1M	1D	1W	1M	1D	1W	1M	1D	1W	1M
FA	0.0	0.2	0.0	1.5	4.1	4.6	3.5	6.5	7.0	3.6	8.4	8.4	12	14	13	17	19	20
ST	0.0	0.0	0.2	3.3	6.1	7.2	4.7	8.4	8.5	6.8	11.0	12.0	16	17	16	23	26	27
WRT-1	8.0	10.0	11.0	39.0	37.0	39.0	63.0	63.0	65.0	92.0	98.0	100.0	112	110	110	135	138	140
AJ-1	10.0	14.0	12.0	44.0	42.0	43.0	59.0	64.0	65.0	81.0	86.0	83.0	98	101	99	130	131	134
BJ-1	6.0	5.0	5.0	25.0	22.0	23.0	33.0	32.0	33.0	46.0	46.0	47.0	54	53	52	84	85	86
C-1	0.0	0.5	0.0	14.0	12.0	13.0	20.0	18.0	18.0	28.0	27.0	27.0	34	33	33	52	53	53
D-1	0.0	–1.0	–4.0	3.0	7.0	7.5	8.0	10.0	10.0	16.0	18.0	18.0	20	22	22	33	31	34
WRT-2	3.0	3.0	4.0	24.0	23.0	24.0	45.0	43.0	45.0	67.0	70.0	72.0	77	76	76	115	112	118
AJ-2	4.0	6.0	7.0	31.0	29.0	29.0	48.0	48.0	48.0	60.0	60.0	64.0	74	74	72	110	112	114
BJ-2	0.7	0.0	–1.0	15.0	13.0	14.0	23.0	23.0	24.0	33.0	32.0	34.0	39	40	39	59	59	60
C-2	0.0	0.0	–2.0	9.0	8.0	8.0	12.0	10.0	11.0	17.0	16.0	19.0	23	20	22	37	38	42
D-2	0.0	–1.0	–4.0	3.0	3.0	2.0	4.0	7.0	6.0	6.0	10.0	8.0	11	13	12	24	22	21

TABLE II—PER CENT VOLUME SWELL OF TEST ELASTOMERS IN TEST FUEL COMPOUNDED AT ROOM TEMPERATURE (CONT'D.)

(1D = 1 day; 1W = 1 week; 1M = 1 month)

	Test Fuel — 70% arom.			Test Fuel — 100% arom.			Xylene			Toluene			Benzene			Aviation Gas 115/145		
	1D	1W	1M	1D	1W	1M	1D	1W	1M	1D	1W	1M	1D	1W	1M	1D	1W	1M
FA	23	24	25	52	56	58	31	36	36	56	55	57	102	104	105	1	2.5	2.5
ST	34	36	34	75	73	75	46	47	46	75	72	74	128	129	130	2	4.0	4.0
WRT-1	152	154	153	182	184	184	184	186	186	190	195	200	184	186	186	24	22.0	22.0
AJ-1	148	150	151	190	192	190	185	187	188	200	201	200	215	217	216	25	24.0	24.0
BJ-1	105	106	108	171	170	168	155	154	155	170	168	167	180	178	176	16	16.0	16.0
C-1	74	75	74	123	120	121	105	99	99	123	121	120	135	132	132	13	12.0	13.0
D-1	45	45	51	86	85	83	78	76	75	98	97	96	122	120	118	10	8.0	6.0
WRT-2	128	130	131	160	162	163	152	156	156	159	165	167	154	156	155	14	12.0	12.0
AJ-2	126	128	130	165	168	166	164	164	164	170	171	170	198	197	195	10	11.0	12.0
BJ-2	85	86	87	142	145	141	128	127	126	144	143	142	163	161	159	8	6.0	6.0
C-2	55	57	60	93	96	92	62	60	55	75	72	70	93	89	89	6	6.0	5.0
D-2	30	28	27	51	52	50	39	37	36	50	49	48	70	65	64	2	1.0	1.0

For convenience and ease of interpretation of the data, the following designations have been given these rubbers. As indicated, they correspond to the letter code in the trade name which serves to identify the type of each material:

FA	— Polysulfide rubber type FA,
ST	— Polysulfide rubber type ST,
WRT	— Neoprene WRT,
AJ	— Paracril AJ—Low nitrile content,
BJ	— Paracril BJ—Medium nitrile content,
C	— Paracril C—High nitrile content, and
D	— Paracril D—Very high nitrile content.

Since the polysulfides cannot be compounded for the wide range of physical properties obtainable with the other rubbers, it is not possible to compare a single compound of each elastomer on a relatively equal basis. Therefore, two compounds of each elastomer, except the polysulfides, were used to obtain comparisons under conditions fulfilled by the same polysulfide compound. These are: (1) Approximately equal volume loading levels, and (2) Approximately equal physical properties.

The use of two compounds is also of value in observing the effect of increased aromatics on the gains in reduced swell and retained physicals which generally result from higher loadings. Compound formulations presented in Table I which correspond to the above conditions are identified as number 1 or 2 respectively.

Commercial high octane gasolines, purchased from service stations in the Trenton, New Jersey, area, were used for test fuels representing aromatic concentrations in the 25 to 45 per cent range. Those fuels with the higher percentages of aromatics are laboratory blends, by volume, of the following components:

Isooctane	100 — 0%		
Aromatic Mixture	0 — 100%	Xylene	40%
		Toluene	40%
		Benzene	20%

While the above does not conform exactly to any existing test fuel specification or take into account probable olefin content, fuels made to this formula and compared with commercial fuels of equal aromatic content have given results which closely agree. ASTM procedures were used throughout this work except if otherwise indicated.

Volume Swell

The percentage increases in volume, after immersion in fuels of varying aromatic content, are tabulated in Table II. It is quite apparent that increasing the aromatic component has a marked swelling effect on all the rubbers. However, immersion periods of up to a month duration have contributed little to this effect and reveal no conclusive evidence of the existence of an incremental or continuing swell and eventual deterioration *(5)*. Should this condition exist with any of these rubbers, it must be assumed that it progresses at an extremely slow rate and for all practical purposes can be considered negligible.

TABLE III—PHYSICAL PROPERTIES OF TEST ELASTOMERS AFTER IMMERSION IN TEST FUELS

	Original					Immediate Break								After Drying (24 hr. at R. T. + 24 hr. at 158°F.)							
						Comm. Fuel 25% arom.			Comm. Fuel 45% arom.			Test Fuel 65% arom.			Test Fuel 100% arom.			Comm. Fuel 25% arom.			Comm. Fuel 45% arom.			Test Fuel 65% arom.			Test Fuel 100% arom.		
	T	M	E	S		T	E	S	T	E	S	T	E	S	T	E	S	T	E	S	T	E	S	T	E	S	T	E	S
FA	1130	730	480	71	1 Day	1020	420	68	920	340	67	830	300	56	590	200	47	1040	320	73	1190	340	74	1120	350	72	1200	320	75
					1 Week	990	400	63	880	320	60	790	310	48	600	200	45	1120	350	74	1140	340	74	1200	340	72	1150	320	75
					1 Month	910	400	60	880	320	56	820	300	45	550	200	40	1150	340	73	1100	320	73	1080	340	73	1160	260	76
ST	1020	900	250	70	1 Day	910	220	68	780	180	65	340	120	52	180	120	50	995	220	72	850	200	74	980	200	75	1000	200	75
					1 Week	820	230	64	710	200	59	270	100	50	170	100	48	1010	210	73	925	220	72	1000	200	75	950	200	76
					1 Month	710	220	62	600	160	50	275	100	50	170	100	45	925	200	73	850	200	73	900	180	75	1100	220	76
WRT-1	2450	1340	340	65	1 Day	1510	230	68	1100	150	50	720	130	48	550	100	48	2400	260	75	2490	250	75	2750	260	78	2800	290	78
					1 Week	1600	240	64	1000	160	53	680	130	48	590	110	47	2450	270	75	2340	260	75	2860	290	77	2650	260	78
					1 Month	1450	210	60	950	160	43	650	110	49	550	100	45	2500	240	74	2450	250	75	2800	290	77	2850	270	78
AJ-1	2000	1270	340	62	1 Day	1130	200	54	700	140	46	640	110	47	400	140	44	2100	270	72	2390	280	72	2000	250	73	2025	280	73
					1 Week	1080	200	54	780	150	48	680	110	44	450	140	44	2010	260	74	2140	270	72	2210	270	73	2280	260	73
					1 Month	1190	200	56	700	120	47	640	90	45	400	130	43	2120	250	74	2050	260	73	2040	250	73	2050	280	72
BJ-1	1860	950	370	62	1 Day	1290	260	54	940	220	49	600	140	47	390	100	43	1820	350	70	1930	360	72	1800	330	73	2010	320	73
					1 Week	1040	250	54	890	190	52	600	130	46	400	110	42	1900	350	72	1750	320	70	1925	350	72	1900	320	73
					1 Month	1180	210	56	820	180	47	640	110	45	380	100	42	2110	360	72	1850	350	72	1970	350	73	1920	320	74
C-1	1900	1200	370	65	1 Day	1560	310	61	1180	240	59	850	160	48	590	120	44	1850	300	71	1900	320	74	1860	310	70	2125	330	75
					1 Week	1450	310	59	1110	250	54	750	150	47	550	120	42	1975	300	73	1925	330	74	2000	330	74	2010	310	76
					1 Month	1400	280	58	1120	240	48	800	160	50	500	110	42	1760	280	74	1850	310	74	1850	320	75	2160	320	74
D-1	2070	1680	290	72	1 Day	1850	260	72	1590	250	70	1100	200	58	720	130	46	1950	280	76	1760	300	79	2100	280	80	2025	250	82
					1 Week	1700	270	70	1500	250	61	900	140	54	800	140	45	2000	280	77	1950	280	76	2040	260	81	1950	240	82
					1 Month	1780	300	67	1400	230	59	1100	170	55	750	130	45	1880	270	76	1880	260	79	2040	260	80	1980	260	82
WRT-2	1500	990	310	65	1 Day	1090	280	68	840	220	44	650	170	42	500	150	42	1490	290	82	1420	280	85	1470	290	84	1340	290	84
					1 Week	1150	280	57	750	190	44	610	160	38	480	140	40	1350	260	81	1350	250	84	1410	280	84	1420	290	84
					1 Month	1060	240	55	750	200	44	620	170	42	450	130	39	1525	270	82	1400	250	85	1360	260	85	1320	280	83
AJ-2	1070	760	400	63	1 Day	720	260	47	530	160	43	400	120	41	280	110	42	1200	290	74	1290	310	75	1140	310	74	1100	320	74
					1 Week	590	220	50	490	150	42	350	120	40	250	100	41	1060	280	74	1000	290	75	1050	280	75	1080	310	75
					1 Month	560	210	47	450	120	41	400	140	44	280	100	39	1130	290	75	1125	300	75	1200	300	75	1120	300	75
BJ-2	910	530	410	63	1 Day	700	300	52	560	250	45	450	150	44	310	120	40	920	300	74	950	310	75	980	310	76	1000	320	77
					1 Week	650	290	48	570	260	46	375	140	40	300	120	40	980	310	72	900	310	73	1000	320	77	950	300	75
					1 Month	610	240	48	520	220	46	400	150	45	290	100	38	1020	310	73	860	300	73	930	300	77	960	290	74
C-2	1000	780	410	66	1 Day	820	350	56	650	230	52	530	180	46	380	140	42	980	300	75	860	320	80	1100	320	78	1050	310	80
					1 Week	810	320	58	620	200	46	500	170	44	350	130	40	950	300	74	880	300	75	1020	300	78	890	290	80
					1 Month	710	310	56	610	210	48	550	180	48	300	130	40	1050	320	75	1000	340	78	980	300	80	1000	300	80
D-2	1200	950	300	72	1 Day	1080	300	72	870	220	65	620	200	57	445	120	50	1100	250	78	890	240	82	950	240	82	950	230	83
					1 Week	900	290	65	850	230	61	580	210	55	410	100	48	850	240	79	1000	240	80	1200	250	82	1125	240	82
					1 Month	940	300	60	730	210	55	550	190	57	410	100	46	1210	260	80	880	230	81	1120	250	83	920	200	83

Note: Physicals are based on original unswollen cross-sectional area; T = tensile strength; M = modulus at 200%, E = % elongation and S = Shore A hardness.

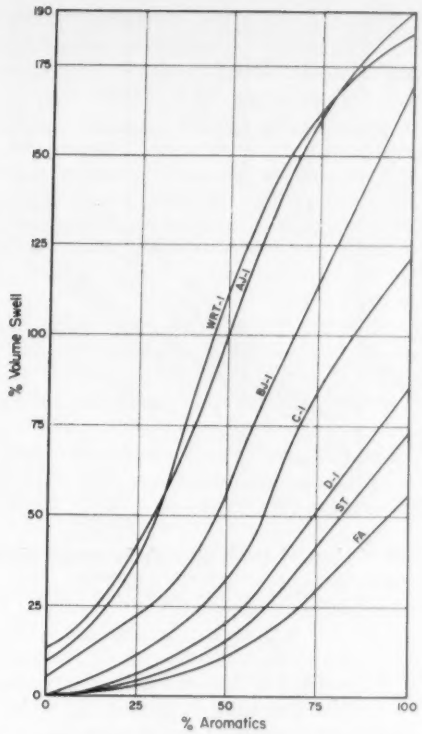

FIG. 1—Volume swell of compounds at equivalent loading levels.
(Immersed one week at room temperature)

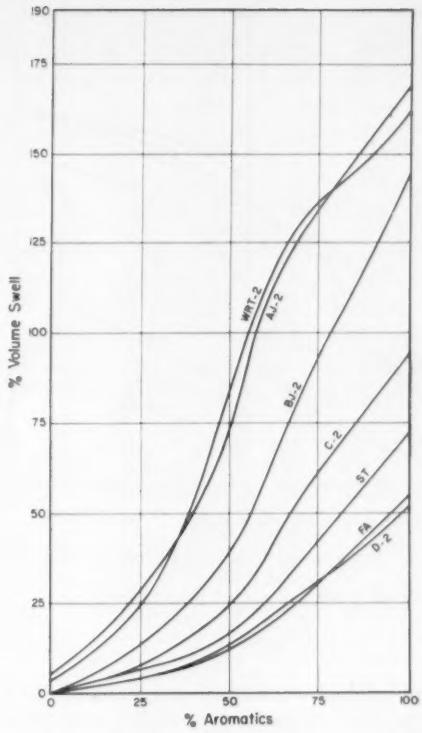

FIG. 2—Volume swell of compounds with equivalent physical properties.
(Immersed one week at room temperature)

Figures 1 and 2 illustrate quite effectively the influence of increased aromatics on the individual elastomers. Figure 1 shows that the resistance to swell changes radically after a specific aromatic level is reached. The degree of change and the aromatic concentration at which the change occurs differs with each rubber depending on its relative oil-resistant properties. It is interesting to note in Figure 2 that while the actual swell values are lower—as would be expected with more highly loaded compounds—the over-all curve pattern has been practically unaffected.

In addition to the test fuels and commercial gasolines used, all compounds were tested for swell in each individual test fuel component. This was done, particularly with the aromatics, to observe to what degree each is responsible for swell. As shown in Table II the aliphatic, isooctane, has contributed little or nothing to the swells obtained with the various fuels. The aromatics, however, reveal data which are quite interesting. Except for neoprene, which appears just about equally affected by each aromatic, xylene exhibits the least swelling effect and benzene the highest on these rubbers. Toluene is intermediate and gives values which correspond closely with those obtained with the test fuel containing 100 per cent mixed aromatics. Aviation gasoline is quite high in alkylates (branched chain aliphatics) and consequently, the volume swell of all elastomers is low in this fuel.

Physical Properties

As with volume swell, the loss of physical properties after immersion is dependent on the percentage of aromatics in the fuels and the relative oil resistance of the elastomer. Table III gives the values obtained after immersion intervals of one day, one week and one month. Again, as with volume swell, there appears to be no obvious trend or pattern to indicate that time of immersion is more than a negligible factor in continued reduction of physical properties.

Further work of a more quantitative nature and lengthier exposure periods would be necessary to reach more definite conclusions. Past performance of these elastomers in contact with fuels in the lower aromatic range, however, would appear to justify the assumption that the time element may also be ignored in the more highly aromatic fuels. The exception which may serve to distort this picture is the effect of additives. Some of these chemicals, particularly newer ones, are trade secrets and unknown to the rubber compounder, so that he is unable to evaluate their effect. To futher complicate matters these materials are generally present only in small concentrations and observable deterioration may take a considerable length of time.

It is quite apparent from the dried physicals that no apparent residual loss of properties occurs as a result of increasing aromatics or prolonged fuel contact. In general the physicals obtained after drying closely

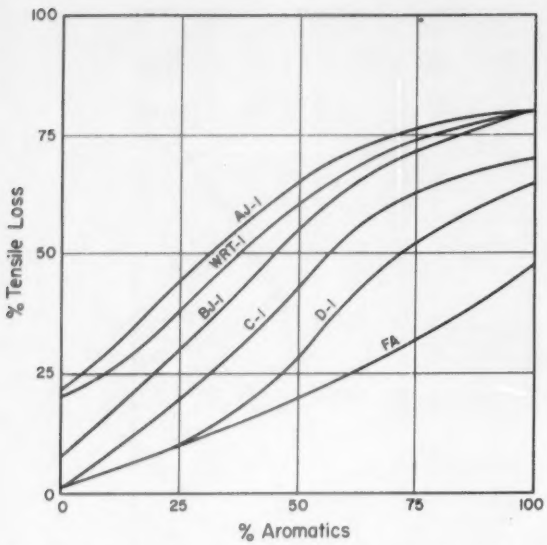

FIG. 3—Loss of tensile strength for compounds at equivalent loading levels.
(Immersed one day at room temperature)

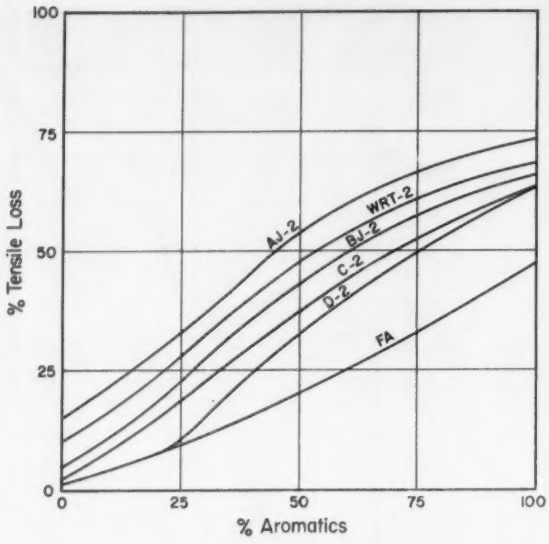

FIG. 4—Loss of tensile strength for compounds with equivalent physical properties.
(Immersed one day at room temperature)

approach the original values except for changes that would be expected as a result of plasticizer extraction. This is quite evident in the increased hardness and reduced elongation values given in Table III.

Figures 3 and 4 show the precentage tensile lost as fuel aromaticity is increased. In contrast to volume swell the loss of tensile proceeds at a more rapid rate in the lower ranges of aromatics than in the high. In Figure 3 somewhat the opposite effect of that obtained for volume swell is illustrated. Here, with the exception of the polysulfide FA, all elastomers lose tensile rapidly and at about the same rate with a pronounced tapering off at about 65 per cent aromatics. The influence of higher loading, as indicated in Figure 4, is a reduction in tensile loss, particularly at the 65 per cent level of aromatics. The over-all effect is thus one of a steady more uniform rate of loss, closely approaching that of the polysulfide FA.

In general, it would appear that the lower limits of percentage loss of physicals and the rate of approach to these limits are influenced to a significant degree by the volume of elastomer in the compound.

Because of its nonconformance to the general pattern of the other elastomers, curves for the polysulfide ST were omitted from Figures 3 and 4. As can be observed in Table III the loss of tensile above 50 per cent aromatics is extremely high, and indicative of a radical change in the rate of percentage loss.

Low Temperature Performance

The advent of higher aromatic fuels threatens to aggravate an already troublesome problem with which compounders have to cope. This involves the development of compounds for products which must possess not only excellent fuel resistance, but also must give good performance at very low temperatures.

A modified Gehman Torsional apparatus was used to obtain the data in Figure 5, which shows the temperature at which the shear modulus, G value, for each compound is 10,000 psi. This is generally considered to be the stiffness limit for practical application. It is apparent that, with the exception of the polysulfides, the polymers which show the best resistance to low temperature stiffening are those which have exhibited the poorest fuel resistance. With the nitrile rubbers there is a progressive sacrifice in low temperature flexibility as gains are made in resistance to aromatics.

The addition of low temperature ester type plasticizers lowers the stiffening temperature significantly, but these esters are very soluble in aromatics and, therefore, readily extracted, as can be observed in Figure 5. Since the plasticizer concentration is higher in the more highly loaded compounds, they show better original values. However, it is evident that

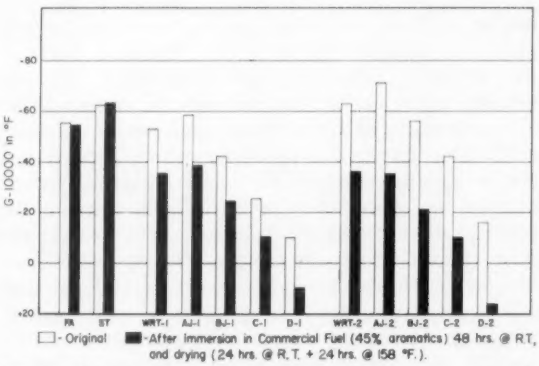

FIG. 5—Comparison of low temperature stiffness of compounds before and after immersion.

extraction quickly neutralizes any gains made, if drying or evaporation of fuel occurs.

The polysulfides, which inherently possess good resistance to low temperature stiffening, need no plasticizer and are excellent for this difficult combination of low temperature and swell-resistant properties. A compromise which also would appear to merit consideration for the solution to this problem is a blending of polysulfides with the other elastomers *(6)*.

Permeability

The rate of diffusion of aromatic fuels through the different elastomers appears closely related to the degree of swell encountered, and consequently is quite dependent on the percentage of aromatics present. In Figure 6, the curves for each compound are characterized by a sharp change in permeation rate at a critical aromatic level. Once more, as with volume swell, the degree of change varies with the relative oil-resistant properties of the elastomer.

These results would appear to be supported by the work of Mueller *(7)*, who indicated that the solubility of an organic liquid in the elastomer is an important factor governing the rate of permeation. Hence, as would be expected, the more aromatic-resistant rubbers show the best performance, with the polysulfides particularly outstanding. Although the effect of loading has not been studied, the above conclusions would seemingly justify the assumption that some improvement will result from more highly filled compounds.

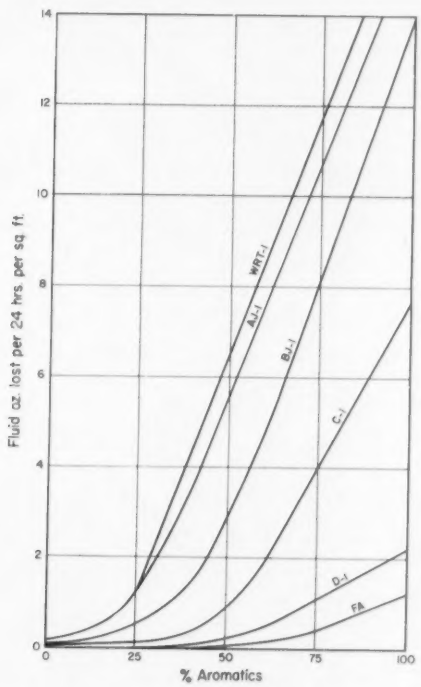

FIG. 6—Change in rate of permeability with increasing aromatics.

TABLE IV—EFFECT OF CYCLIC IMMERSION AND DRYING OF TEST ELASTOMERS ON VOLUME SWELL AND PHYSICAL PROPERTIES

% Volume Swell (48 hrs. at R.T. in Comm. Fuel, 45% arom.)

	Immediate			After Drying (24 hr. at 158°F.)		
	FA	WRT-1	BJ-1	FA	WRT-1	BJ-1
1st cycle	7.6	103	57	–0.8	–12.5	–7.6
2nd cycle	11.0	120	71	–1.5	–13.0	–7.0
3rd cycle	11.0	123	75	–1.6	–12.0	–7.2

Physical Properties

1st cycle	Ten.	990	1040	900	1250	2990	1960
	% Elong.	330	190	180	390	290	330
	Shore A	66	49	50	73	75	72
2nd cycle	Ten.	970	990	910	1240	3000	2240
	% Elong.	320	180	180	340	280	380
	Shore A	62	50	49	74	81	73
3rd cycle	Ten.	980	1060	910	1250	2750	1980
	% Elong.	310	150	180	370	250	320
	Shore A	65	50	49	72	78	74

Effect of Cyclic Fuel Contact

It has already been pointed out that the loss of plasticizer by extraction has a detrimental effect on the low temperature resistance of the compounds tested. To demonstrate that the initial swell and dry volume values are also significantly altered as a result of plasticizer loss, and to observe any further effects, specimens of the compounds designated in Table IV were subjected to a series of three immersion and drying cycles.

As indicated, those compounds containing plasticizer exhibit much higher swells and appreciable shrinkages after the initial cycle. However, physical properties are unaffected by this cycling procedure which approaches conditions frequently encountered under actual service conditions. While increased aromatics will change the actual values obtained, it is concluded that except where shrinkage and low temperature are quite critical factors, intermittant fuel exposure, in itself, has no effect in contributing to shortened service life.

Summary

It has been predicted that fuels for the high performance automobiles of the near future will require an octane number as high as 110. To achieve this objective it is a realistic possibility that an increase in the aromatic ratio of present fuels will be necessary.

Observations of the effects of fuels of varying aromaticity on a number of oil-resistant rubbers have revealed definite limitations regarding the suitability of these elastomers for use in contact with highly aromatic fuels. Only the polysulfide and high nitrile rubbers would appear to have the necessary solvent resistance when aromatics exceed 50 per cent. The best

balance of properties is obtained with the polysulfides alone, although blends with the other elastomers may offer a practical compromise for obtaining good initial physical and processing properties.

ACKNOWLEDGMENT

Grateful acknowledgment is made to V. H. Perrine for recommending this study and for his suggestions in carrying out the work. A great deal of credit is also due the personnel of the Technical Service Department for their competent handling of the very extensive and bulky program.

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Infrared Spectroscopy in the Rubber Industry

INFRARED spectroscopy has been extensively applied to research problems in the rubber industry. Uses have included spectroscopic correlation for different patterns about the C:C linkage, which has aided greatly in the investigations of the structure and reactions of monomers, polymers and synthetic polydienes. Other applications have been study of rubber oxidation and rubber derivatives; control of sulfur vulcanization to follow reactions of sulfur with model compounds, and study of crystallinity and chain ionfiguration. It has also been used in identifying the types of polyisoprene from different plants, and in following the chlorination and hydrochlorination of rubber.

An advance in infrared instrumentation was the introduction 18 months ago by Perkin-Elmer Corp., Norwalk, Conn., of a low-cost spectrophotometer designed to provide the organic chemist with a rapid means of obtaining routine infrared analyses, and to make the technique available to the smaller laboratory. Cost of the spectrophotometer is said to be one-third that of the standard research unit.

Coming Next Month...

Identification of Carbon Blacks by Centrifugation and Spectrophotometric Measurements — by A. Fiorenza, Rubber Laboratories, Pirelli, S. p. A., Milan, Italy

Description of a method designed to overcome certain limitations of the spectrophotometric technique for identifying carbon blacks in rubber.

The Future of Natural Rubber—By John McGavack, U. S. Rubber Co., New York, N. Y.

An analysis of the status of natural rubber which indicates that the future was never rosier, plus a description of the stimulation technique used to achieve increased yields.

How to Get More Information from the Readings of Rotational Viscometers—By A. L. Back, A. L. Back & Associates, West Chester, Penna.

The rotational viscometer gives more information about the viscous properties of fluids than is usually apparent; instructions on how to obtain additional data are given.

PLUS A R/A SPECIAL INDUSTRY REPORT

SBA Loans

A thorough inquiry into the loan policies of the Small Business Administration which tells how the small rubber goods manufacturer can benefit.

A new, simpler and more flexible system for Compounding Silicone Rubber

Use of a base material with specially designed technological data from the manufacturer permits the fabricator to compound the stocks which meet his needs

A NEW silicone rubber compounding system recently developed and put into commercial production by the Silicones Division of Union Carbide Corporation is designed to make the compounding operation more flexible than it has been to the present, and to give the fabricator broader and more simplified control over the properties and cost of the rubber he produces. Basis of the new technique is a silicone rubber base compound, to which the fabricator adds his own fillers to formulate stocks that meet specific requirements as to physical properties and cost. In short, by utilizing the new product he can now achieve a much greater degree of flexibility in compounding silicone rubber and also develop proprietary formulas to his own competitive advantage.

Until now, the fabricator working with silicone rubber has had two avenues of approach. First, he could purchase gum stock and formulate his own compounds. Because of the need for specialized technical experience and processing techniques, however, he was at great disadvantage in achieving the maximum in economy and physical properties.

The second approach was to purchase standard silicone rubber stocks which were available for most applications. The limitation in this procedure is that the variety of standard compounds needed to fill various applications necessitates large, diversified inventories. Also, the fabricator would frequently use a compound that far exceeded his specific requirements because it was "available." This seriously limited his flexibility in relating costs to the requirements of the application.

Now, according to technical personnel of the Silicones Division of Union Carbide, who have released the facts and figures reported in this article, these limitations have been overcome by employing the new system. The method features two components: use of the base compound, which has been designed XKW-1300, and an organized presentation of data designed to guide the fabricator in the selection of those specific recipes, using the base compound, which will best fulfill his cost and physical property requirements.

The base is a nominal 30 durometer silicone rubber compound which has, in itself, all the desirable features of high quality silicone compounds in the 30 durometer class. These features include pre-conditioning, good thermal stability, low compression set and low shrinkage characteristics. Other properties are neutral color and a specific gravity of 1.11.

The base compound is currently being manufactured for commercial use at the plant of the Silicones Division in Long Reach, West Virginia. It is boxed

FIG. 1—The new silicone rubber base compound as it is received from the manufacturer, ready to be put on a two-roll mill for addition of fillers.

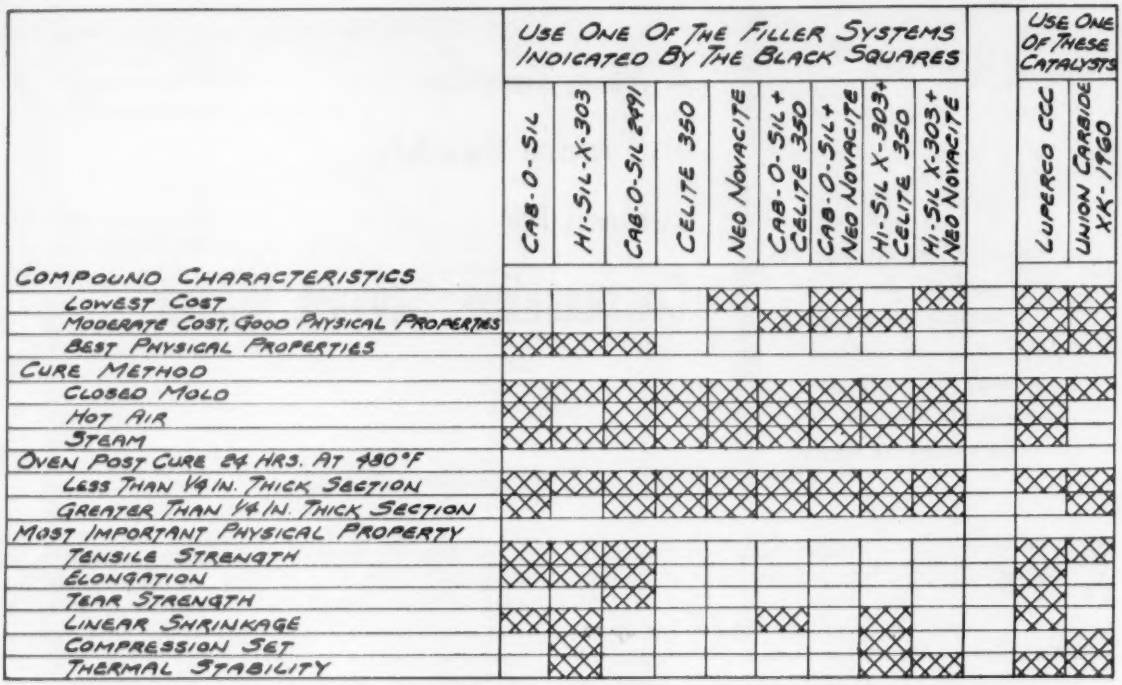

FIG. 2—Guide to filler systems for use with XKW-1300 silicone rubber base compounds to meet various requirements.

and shipped as slabs of sheet stock in packages that weigh 25 and 50 pounds.

When it reaches the consumer it is in the form seen in Figure 1, which shows the compound as it is being put on a two-roll mill for incorporation of fillers and curing agents. The mill, incidentally, is the only piece of equipment required for the compounding. There is no need for bin aging, and processing time is greatly shortened. The fabricator sheets the masterbatch on the mill for a very short period to refreshen it, and then simply adds the necessary fillers to produce the stock which meets his requirements. Compounds made from XKW-1300 can be cured by hot air, steam or mold methods, with selection of proper fillers and catalysts (see Figure 2).

Organized Presentation of Data

The efficient use of the new system depends on the addition to the base of the correct amounts of the appropriate fillers and curing agents. An organized presentation of data has been designed to provide the fabricator with the information necessary to accomplish this.

The fillers commonly used in silicone rubber can be divided into two types: reinforcing and non-reinforcing. The reinforcing fillers are fine particle size silicas (for example, Cab-O-Sil, Hi-Sil X-303 and Cab-O-Sil 2491). These impart maximum strength and resilience to the compound. They are relatively expensive ($.40 to $1.20 per pound), however, and are generally used alone only in compounds which require a maximum of physical properties.

Non-reinforcing fillers (Celite 350 and Neo Novacite and others) are relatively inexpensive ($.02 to $.20 per pound) and can be used as extenders, greatly reducing the cost of the stock. These fillers, however, impart little reinforcement and, therefore, can be used by themselves only in stocks which can tolerate minimum physical properties. It should be noted, however, that certain required properties in some compounds cannot be achieved without the use of some extender.

In the majority of cases, a combination of reinforcing and non-reinforcing fillers will yield the most desirable median between cost and physical properties. To aid the fabricator in the selection of the appropriate fillers and curing agents, the Silicones Division has developed a system which permits an analysis of the different variables—physical properties and costs as determined by kind and proportionate amounts of the fillers—with maximum ease and clarity. Figure 2 shows basic information on choices of each to meet specific requirements. Perusal of this basic guide can save considerable time and effort in the study of recipes. The flexibility of the system has resulted in a greatly reduced inventory of rubber stocks and compounding ingredients.

At least as important as the selection of the appropriate fillers and curing agents is the determination of the proper amount of each to add to the base to achieve the desired properties at the most economical price. To guide the fabricator, all such information is readily determined by using graphs which are an integral part of the system (Figures 3 through 6). They describe the physical property and cost characteristics

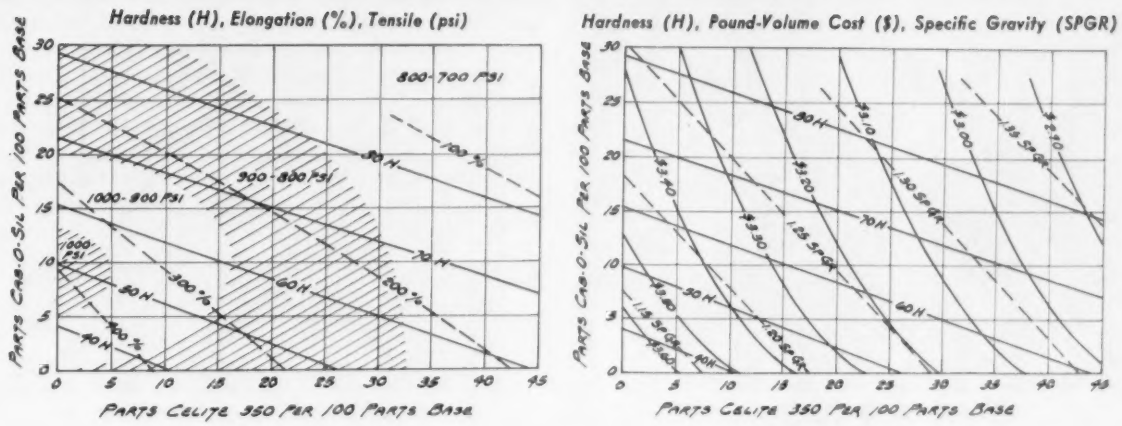

FIG. 3—Guide for using the Cab-O-Sil-Celite 350 filler system with XKW-1300 base compound.

of the XKW-1300 based compounds containing the commonly used reinforcing and non-reinforcing fillers.

Two graphs are used here to present the physical property and cost characteristics of each filler system. One graph presents data on hardness, specific gravity and pound-volume cost, while the other presents hardness, elongation and tensile strength. The cost curves are based on current prices, and naturally are subject to change.

In each set of graphs the properties have been plotted as a function of formulation using the loading of each filler as an axis. Constant hardness, elongation, specific gravity and cost per pound-volume lines and tensile strength areas provide an easy method of selecting the recipe which best fills the requirements of an application.

For example, the fabricator takes his known information, usually the physical requirements of the compound—tensile, elongation and hardness. He then studies the graphs, where he can determine and compare the pound-volume costs and specific gravities of each of the recipes that meets the requirements. Or, if cost is the major factor, he can reverse the procedure and find what properties he can get for a predetermined price. The graphs are accurate enough to permit interpolation between the lines, so that approximations are realistic.

Curing Agents

The selection of the appropriate amount of curing agent is dependent, to a great extent, upon the requirements of the application. Certain standard loadings, are, however, suggested to yield the most desirable combination of physical properties for most uses. These loadings are one part of 2,4-dichlorobenzoylperoxide paste (Luperco CCC or Cadox TS [40%] are commonly used) or 3.3 parts of Union Carbide XK-

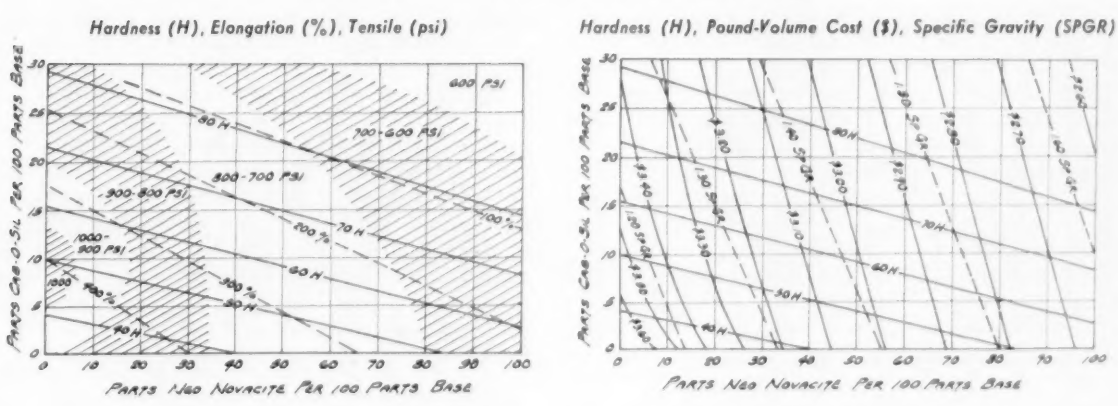

FIG. 4—Guide for using the Cab-O-Sil-Neo Novacite filler system with XKW-1300 base compound.

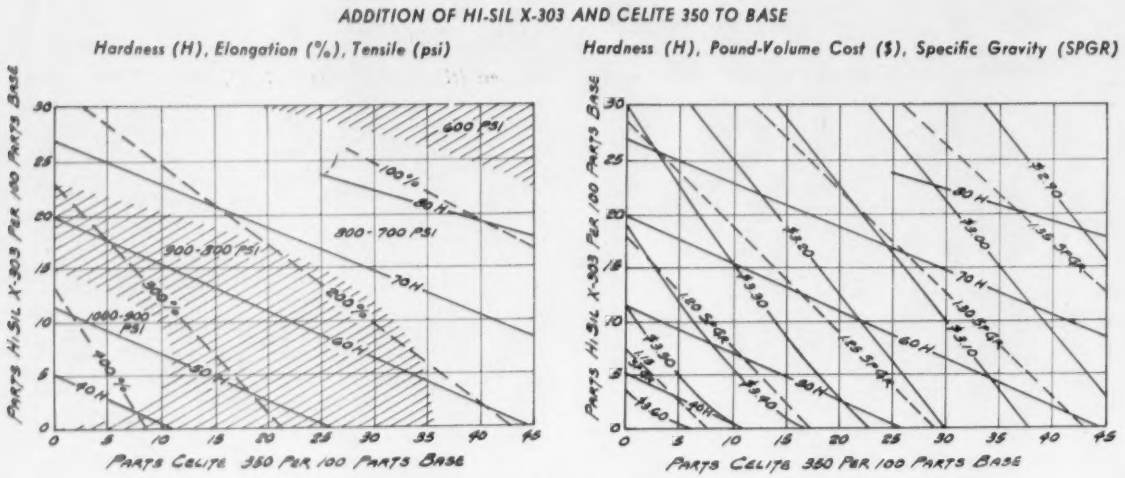

FIG. 5—Guide for using the Hi-Sil X-303-Celite 350 filler system with XKW-1300 base compound.

1960 (a masterbatch of ditertiary butyl peroxide saturated Linde molecular sieves in Union Carbide W-96 gum stock) per 100 parts of the base compound. All data presented in the graphs in this article were obtained using one part of Luperco CCC per 100 parts of base, mold cure 15 minutes at 250°F., postcure 24 hours at 480°F.

Other catalyst loadings have been successfully used in specific applications, however. For example, about one-half the recommended 2,4-dichlorobenzoylperoxide loading is used in the XKW-1300 by itself to yield very low (10 to 20) durometer compounds, while higher loadings of this catalyst can be used to prepare high modulus compounds in the 40 to 60 durometer range.

The fabricator has further control over compound properties by adjusting postcure cycles. In general, a shorter postcure will increase tensiles, elongations and compression sets, and reduce hardness in relation to the data shown in Figure 3 through 6.

A Practical Example

An example will give an idea of how the system works. A fabricator making silicone rubber molded parts for an automotive application wishes to prepare a new compound. To maintain a competitive position he must naturally achieve the lowest cost per pound-volume possible. His customer requires a 50 durometer compound with a minimum of 300% elongation.

The first step is the selection of the appropriate fillers and curing agents. By consulting Figure 1, the fabricator sees that low priced compounds can be prepared using Neo Novacite, or a mixture of Cab-O-Sil and Neo Novacite, or of Hi-Sil X-303 and Neo Novacite.

Then, he turns to Figure 4 which shows the graphs for the Cab-O-Sil-Neo Novacite filler system. Evaluating the possibility of using only Neo Novacite, he runs across the physical property graph at zero parts Cab-O-Sil. A 50 durometer compound will be produced by

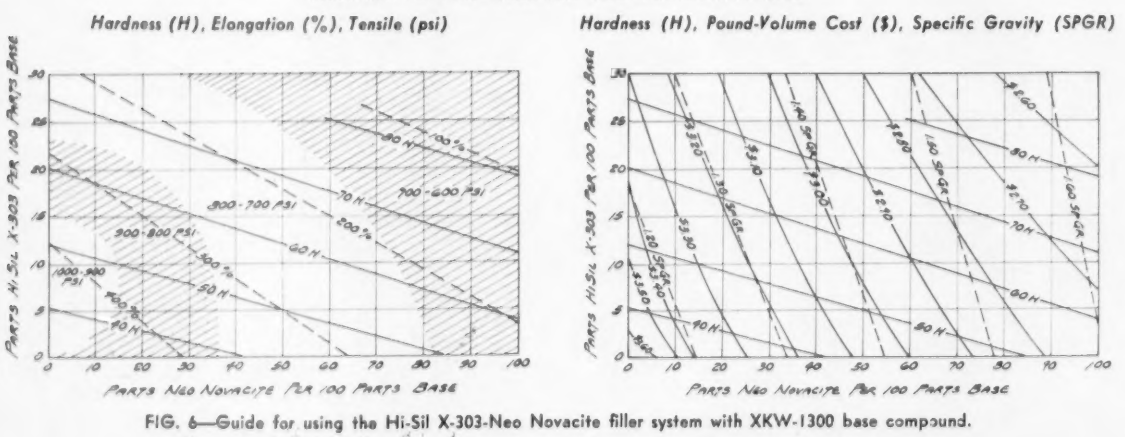

FIG. 6—Guide for using the Hi-Sil X-303-Neo Novacite filler system with XKW-1300 base compound.

using approximately 83 parts of Neo Novacite per 100 parts of base. The elongation of this stock, however, as shown by the elongation lines, lies approximately midway between 200 and 300%. This compound, then, will not meet the physical property requirements.

Next, he determines the possibility of using the Cab-O-Sil-Neo-Novacite combination. The 50 durometer line crosses the 300% elongation line at a point which indicates approximately a 52 part Neo Novacite and four part Cab-O-Sil loading. The pound-volume cost of this stock, as shown on the companion graph, is about $3.02. This stock is a possibility.

For the sake of comparison, he then considers the Neo Novacite-Hi-Sil X-303 system, as shown in Figure 6. The graphs indicate that the 50 durometer line crosses the 300% elongation line at a point which indicates a stock of 100 parts base to 50 parts Neo Novacite and five parts Hi-Sil X-303. The pound-volume cost of this stock is also within the $3.00 range.

Thus, two of the formulas yield stocks of the desired physical properties, and being of approximately the same cost, could be evaluated as potentially acceptable recipes. In the majority of cases, several will generally be found to meet a given set of requirements.

Summary

The development of this new system for compounding silicone rubber is believed to be a major step toward the improvement of the competitive position of the fabricator, since it improves his ability to make compounds "tailored to the job" at the lowest cost to himself. The manufacturer is backing up the new venture with its own technical service personnel, who are available to help the fabricator with any processing problems he might encounter. Also, current research work is underway to expand the available information of the effects and advantages of additional fillers. The new base compound has already been used commercially with success. Some of the products manufactured from it are shown in Figure 7.

FIG. 7—Some of the molded and extruded products which have been manufactured from the new base compound.

The system, which consists of a base compound and a systematic presentation of the technological data necessary to use it effectively, is designed to make the fabricator his own silicone rubber compound supplier and thereby let him enjoy the economic advantages of minimum compound inventories, greater flexibility in compound preparation and greater control over compound cost.

Improved Aluminum Silicate Extender Pigments

ALUMINUM silicate pigments have been in use for a long time as extenders or fillers in rubber and other products. Now, however, they not only extend the relatively higher-priced components of these products—they also improve the performances of the base materials and often enable them to do jobs which they could not perform alone.

The additional benefits from aluminum silicate pigments have been derived through research and product application work. Minerals & Chemicals Corp. of America, Menlo Park, N. J., is at the forefront of the effort with its pigments (known as ASP's). It is furthering the pioneering development of Edgar Brothers Co., which has merged with the company.

Product improvements achieved by the improved aluminum silicate pigments are many. In rubber they produce faster cures, and also aid in the adjustment and control of extrusion properties. All of the improvements and controls are accompanied by lower over-all material costs for the product, according to the manufacturer.

Improvements in the pigments are obtained by surface treatment which causes them to take on special properties. The surface-modified ASP's are available in grades of three different average particle sizes, 0.55, 0.8 and 4.8 micron. The particle shapes are all thin flat plates or stacks of plates. They are specially processed from kaolin to remove hard particles, sand, mica, water-soluble salts as well as moisture.

There are seven surface-treated ASP's available. One is surface treated with 0.5 stearate; two with dispersing agents, and four with organophilic surfactants. The latter four have applications in organic systems where their special coatings improve wetability (and dispersion) of the pigments, lower viscosities of highly loaded systems, and improve suspension.

NATURAL RUBBER COMPOUNDS

for High Temperature Service

THE DEVELOPMENT of supersonic aircraft and missiles and of rocket and jet motors for their propulsion has given rise to demands for elastomers capable of withstanding temperatures of 200°C. and more, often in contact with lubricants or hydraulic fluids. These developments, whose importance for defense and for progress in civil transportation is self-evident, have emphasized the need for new and mainly inorganic polymers, and have tended perhaps to direct attention away from the complementary need to extend the aging resistance of natural and the more familiar synthetic rubbers.

It has to be remembered that a much greater volume of rubber is used and will continue to be used for applications requiring heat resistance of a lower order than that demanded by the above developments. For two main reasons special purpose elastomers appear unlikely to meet the requirements arising, for example, in certain conveyor and transmission belts, certain air and fluid seals, hot water and steam hoses and in an item of increasing importance, high-speed tires. First—a technical point—the extreme heat resistance requirement is so vital that inferior technical properties such as elasticity, strength, and cracking resistance at more normal temperatures are often acceptable for the special products but are unacceptable in the conventional products. Secondly—an economic point—for more commonplace industrial products the high cost of such special polymers cannot be tolerated.

Hence, any techniques which may confer greater heat resistance on general purpose elastomers deserve to be fully explored. This paper is concerned with the compounding of natural rubber to give improved heat resistance.

It might appear logical to consider separately methods of vulcanization and methods of protection as factors bearing upon heat aging. An alternative approach is to consider fully each vulcanizing system and the various protective methods which are effective therein. As will be discussed later, vulcanization with thiuram disulfide and zinc oxide without added sulfur, leads to the formation of dithiocarbamate *(1-4)* which is found to function as an aging inhibitor *(5, 6)*. Furthermore, certain protectors are found to be active only in specific types of vuncanizate *(5)*, and therefore the alternative approach appears to be most appropriate to the present study.

Compounding and Test Methods

Pure gum compounds were mixed on a 12 x 6-inch two-roll mill. In the case of filler loaded stocks, a rubber/filler masterbatch was mixed in a size B Banbury, the mixing being completed on the 12 x 6-inch mill. For tensile strength and associated tests, dumbbell specimens (BS903-A2-1956, Type C) were die cut from a molded sheet approximately 0.1-inch thick. Tensile testing was carried out using a modified Goodbrand machine.

For compression set tests, molded specimens (BS903-A6-1957, Type 1) were prepared and com-

TABLE I—TMT CURES WITH OXIDES OTHER THAN ZINC

Formulas

	Parts
Smoked sheet	100.0
Stearic acid	0.5
TMT	3.0
Metallic oxide	as indicated (equivalent to 2% ZnO)

Oxide	Optimum cure, minutes at 140°C.	TS	EB	M300
None	20	600	1135	40
Chromium sesquioxide	20	810	1195	40
Nickelic oxide	20	910	1160	40
Cadmium oxide		Did not cure		
Ferric oxide	20	1050	1125	60
Bismuth sesquioxide	60	870	1100	40
Aluminum oxide	20	910	1150	40
Zinc oxide	30	2400	775	170
Titanium dioxide	20	800	1220	40
Magnesium oxide	20	1050	1025	60
Stannic oxide	20	820	1145	40
Cupric oxide		Did not cure		
Vanadium pentoxide	60	240	1070	30
Calcium oxide	20	1460	1030	70
Lead monoxide		Did not cure		
Barium oxide		Did not cure		
Tellurium dioxide		Poor cure		
Selenium dioxide		Poor cure		

Note: In all tables TS = tensile strength, lb./in.²; EB = elongation at break, per cent; M300 = modulus, 300% elongation lb./in.²

Note: This paper was originally scheduled for presentation before the Division of Rubber Chemistry, ACS, in Cincinnati, Ohio, May, 1958. It was, however, not presented at that time due to indisposition of the authors.

Compounding a general purpose elastomer for improved heat resistance

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pressed by 25% of their thickness between polished chromium plated steel platens lubricated with silicone oil. Compression set values were calculated as per cent of applied deformation. All aging was carried out in an air oven with ventilation so that between 3 and 10 air changes per hour were achieved.

Sulfurless Thiuram Disulfide Compounds

Effect of Dithiocarbamate. Natural rubber vulcanized with tetramethylthiuram disulfide (TMT), without added sulfur, forms the basis of the earliest heat resistant compounds. The precise chemical mechanism involved in this type of vulcanization has been and still continues to be the subject of research and discussion. Craig, Juve and Davidson *(3)* have shown that zinc dimethyldithiocarbamate (ZMDC) may be recovered by short path distillation from vulcanizates based on TMT and zinc oxide, while Scheele et al *(4)* have demonstrated that two-thirds of the TMT present in such compounds is converted during vulcanization to ZMDC.

Recent work by Dunn and Scanlan *(5)* has established that the heat aging of acetone-extracted TMT vulcanizates, as measured by continuous stress relaxation at 100°C., is strikingly retarded when any one of a large number of dithiocarbamates is incorporated into the vulcanizate by swelling from solution. These two facts suggested that the ZMDC formed *in situ* during TMT vulcanization might account, at least in part, for the recognized good heat aging resistance of such vulcanizates. Experimental evidence supporting this hypothesis has recently been published *(6)*.

A fuller investigation of the protective role of dithiocarbamates has been undertaken, initially by forming them *in situ*. The use of other oxides in place of zinc oxide as activators of TMT vulcanization might be expected to give rise to the corresponding dithiocarbamates; it was found however that none gave a state of cure approaching that of zinc oxide at equivalent concentration (Table I); after aging for three days at 100°C. all other vulcanizates were completely embrittled, whereas that based on zinc oxide still retained a fair proportion of its original properties.

In further experiments a second oxide, in addition to the normal 2% zinc oxide, was added to the standard pure gum formulation to an extent equivalent to an extra 0.5% zinc oxide. Of the 16 oxides used (Table II), most had little effect on cure; cupric oxide and tellurium oxide greatly enhanced the retention of properties after aging for one week at 100°C. This effect was checked in an FEF black compound (Table III) and was confirmed for cupric oxide. The aging of this black-loaded compound was unaffected by inclusion of tellurium oxide.

The third and most direct method for investigating the protective action of dithiocarbamate for TMT vulcanizates was to add the dithiocarbamate directly to the compound, where it would supplement the naturally formed ZMDC. This was done using the FEF black compound of Table III. The dithiocarbamates, added at 2% concentration were ZMDC, zinc dibutyl (ZBDC), copper dimethyl (CuMDC) and tellurium diethyl (TeEDC).

From Table IV it is seen that CuMDC improved aged tensile strength and reduced modulus reversion after 14 days at 100°C. The improvement in aging

TABLE II—AGING OF PURE GUM TMT STOCKS CURED WITH ZINC OXIDE PLUS ANOTHER OXIDE

Formulas

	Parts
Smoked sheet	100.0
Stearic acid	0.5
TMT	3.0
Zinc oxide	2.0
Additional oxide	As indicated (equivalent to 0.5 parts ZnO)

Cure: 60 minutes @ 140°C.

Additional Oxide	Unaged TS	Unaged EB	Unaged M500	Aged 7 days at 100°C. TS	Aged 7 days at 100°C. EB	Aged 7 days at 100°C. M500
None	3240	770	450	830	660	300
Zinc oxide	2640	750	430	1310	720	280
Chromium sesquioxide	3240	780	470	1190	710	300
Nickelic oxide	3240	770	470	810	675	300
Cadmium oxide	2680	820	510	300	575	260
Ferric oxide	3040	780	430	610	750	270
Bismuth sesquioxide	2990	750	480	1570	760	310
Aluminum oxide	3240	775	470	1190	700	280
Titanium dioxide	3190	770	460	1120	730	280
Magnesium oxide	3120	790	430	1070	700	180
Stannic oxide	3330	780	430	1380	730	270
Cupric oxide	2890	750	480	2430	755	440
Vanadium pentoxide	2990	760	440	780	680	240
Calcium oxide	3280	810	410	1550	800	200
Lead monoxide	3060	770	480	1250	760	140
Barium oxide	3240	830	340	1190	850	180
Tellurium dioxide	3280	780	400	2120	715	380
Selenium dioxide	3330	710	560	200	350	—

TABLE III—AGING OF BLACK REINFORCED TMT STOCKS CURED WITH ZINC OXIDE PLUS ANOTHER OXIDE

Formulas

	Parts
Smoked sheet	100
FEF black	50
Zno	2
Stearic acid	2
TMT	3
Copper or tellurium oxide	As indicated

Cure: 60 minutes @ 140°C.

	Aging, days at 100°C.	Control	0.13% CuO	0.5% CuO	0.5% TeO_2
TS	0	2600	2680	2680	2720
	7	1620	1980	1450	1570
	14	230	1050	1180	230
EB	0	430	405	430	405
	7	325	300	325	290
	14	320	310	390	275
M100	0	360	360	340	340
	7	280	360	270	300
	14	60	160	130	90
M300	0	1690	1950	1810	1940
	7	1480	1980	1360	—
	14	210	1050	830	—

was apparent though less marked with ZBDC, while the improvement was marginal with additional ZMDC. TeEDC gave an initially tighter cure (it is in fact known as a vulcanizing agent), lower elongation throughout, a fair degree of improvement in aged tensile and a distinct modulus rise prior to reversion.

Effects of Antioxidants and Deactivator. The compounds discussed above contain no recognized antioxidant. It is well known that certain products such as polymerized trimethyl dihydroquinoline (Flectol H, Agerite Resin D) and di-β-naphthyl-p-phenylene diamine (Santowhite CI, Agerite White) enhance the heat aging resistance of natural rubber compounds when used alone or in combination. This is further shown in Table V.

As a result of the work of Le Bras and others *(7-9)*, attention has been directed to a new class of protective agents which are exemplified by mercaptobenzimidazole (MBI) and which were called deactivators by the originators. Although these exert little protective power when used alone, it has been shown that they act synergistically when used in combination with certain antioxidants to give greatly enhanced heat aging behavior in a wide range of vulcanizate types.

In compounds containing sulfur, it has been established *(10)* that the zinc salt of mercaptobenzimidazole (ZMBI) reacts during aging in such a way as to add cross-links to the system and thus compensate to some extent for the oxidative scission of the network. Durou *(11)* has shown that in heat resistant stocks based on TMT vulcanization, incorporation of ZMBI together with an antioxidant leads to a very high level of heat aging resistance. This effect has been checked in an FEF black compound vulcanized with TMT and zinc oxide (Table V).

The combination of 2% ZMBI with 2% Flectol H compared with the established dual antioxidant pro-

TABLE IV—AGING OF BLACK REINFORCED TMT STOCKS WITH ADDED DITHIOCARBAMATE

Formulas

	Parts
Smoked sheet	100
FEF Black	50
Zinc oxide	2
Stearic acid	2
TMT	3
Dithiocarbamate as indicated	2

Cure: 60 minutes @ 140°C.

	Aging, days at 100°C.	Dithiocarbamate: None	CuMDC	TeEDC	ZMDC	ZBDC
TS	0	2600	2600	2880	3000	2880
	7	1620	1850	1690	1210	1820
	14	230	1440	730	530	710
EB	0	430	405	340	405	435
	7	325	305	175	285	330
	14	320	295	135	240	320
M100	0	360	340	470	380	360
	7	280	380	710	210	270
	14	60	270	530	140	110

TABLE V—AGING OF BLACK REINFORCED TMT STOCKS SHOWING EFFECT OF ANTIOXIDANT OR OF ANTIOXIDANT PLUS ZMBI

Formulas

	Parts
Smoked sheet	100
FEF black	50
Zinc oxide	2
Stearic acid	2
TMT	3
Antioxidant	As indicated

Cure: 60 minutes @ 140°C.

	Aging, days at 100°C.	Antioxidant: None	Flectol H, 2 pt.; Agerite White, 1 pt.	Flectol H, 2 pt.; ZMBI, 2 pt.
TS	0	2600	3060	3090
	14	230	1940	2340
	28	E	930	1570
	56	E	E	340
EB	0	430	485	485
	14	320	395	330
	28	E	285	260
	56	E	E	120
M100	0	360	270	300
	14	60	240	460
	28	E	170	440
	56	E	E	310
CS	14	55	51	65
	28	60	56	76
	56	90	65	81

Note: In all tables E = brittle fracture (elongation < 20%); CS = compression set (constant strain), per cent.

tective system, on aging the vulcanizates at 100°C., offers improved tensile retention, delayed modulus reversion and delayed onset of brittle fracture (elongation less than 20%).

Compression set developed on aging at 100°C. is, however, impaired by ZMBI. Experiments to determine the optimum proportions of antioxidant and ZMBI have indicated that 2% concentration of each gives better tensile aging than other combinations totalling 4% added protective agents.

Protection by Combinations of Antioxidant, Deactivator and Dithiocarbamate. After establishing that the heat aging of the TMT/zinc oxide vulcanizate is improved by addition of certain dithiocarbamates and that the known improvement afforded by mixed antioxidants is increased when they are partially replaced by ZMBI, it is important to determine whether or not the separate improvements can be combined to produce maximum aging resistance. Using the two dithiocarbamates ZBDC and CuMDC suggested by the results of Table IV, six compounds were therefore compared. The results shown in Table VI may be summarized as follows. The addition of ZBDC to the stock protected by antioxidants alone has little effect except to delay reversion of modulus; the addition of CuMDC to the same stock improves tensile retention up to 28 days at 100°C., minimizes modulus changes and increases compression set. In a stock given longer life by use of antioxidant and ZMBI in combination, ZBDC triples the tensile strength at 56 days aging, leads to an increase in modulus in this period and has little effect upon compression set or extensibility.

Different effects follow the introduction of CuMDC to the antioxidant/ZMBI stock; the dithiocarbamate appears to cause more serious loss of properties at the long aging period as shown by complete embrittlement and 100% set after 56 days at 100°C. The implication of this last result is that after long periods of aging CuMDC exerts the expected pro-oxygen action of copper compounds. One interesting effect of the addition of ZBDC to these compounds is the reduction in the bloom which is a normal feature of TMT vulcanizates.

Effects of ZMBI on Other Established Heat-Resistant Formulations. An examination of a number of published heat-resistant natural rubber compounds has revealed only one which has properties approaching those arrived at by the TMT/zinc oxide vulcanizate. This particular formula contains TMT, MBTS, tellurium and zinc oxide, together with a substantial dosage of ZEDC.

Formulations similar to this have been used for cable compounds *(12, 13)*, and from the present work it would be expected that the high concentration of zinc diethyldithiocarbamate would confer good heat resistance on the vulcanizate. In this vulcanizing system the use of ZMBI with Flectol H leads to better heat aging than is obtained by use of the dual antioxidant system comprising Flectol H and Agerite White. Typical figures obtained with pure gum compounds show, after 28 days at 100°C., tensile and

TABLE VI—EFFECT OF COMBINATIONS OF PROTECTIVE AGENTS

Formulas

	Parts
Smoked sheet	100
FEF black	50
Zinc oxide	2
Stearic acid	2
TMT	3
Antioxidants	As indicated by code
A { Flectol H	2
A { Agerite White	1
A/D { Flectol H	2
A/D { ZMBI	2
B—ZDBC	3
C—CuMDC	3

Cure: 60 minutes @ 140°C.

	Aging, days at 100°C.	Antioxidants A	A/D	AB	A/DB	AC	A/DC
TS	0	3060	3090	2980	2880	2950	2790
	14	1940	2340	2190	2210	2050	1970
	28	930	1570	950	1920	1250	1380
	56	E	340	E	1010	E	E
EB	0	485	485	465	470	470	435
	14	395	330	360	290	395	285
	28	285	260	240	285	295	205
	56	E	120	E	140	E	E
M100	0	270	300	230	240	270	410
	14	240	460	440	540	260	530
	28	170	440	310	530	260	570
	56	—	310	—	630	—	—
M300	0	1740	1740	1700	1540	1720	1940
	14	1350	2120	1820	—	1610	—
CS	14	51	65	51	67	61	73
	28	56	76	59	75	67	79
	56	65	81	66	81	86	100

TABLE VII—AGING OF TMT/TELLURIUM VULCANIZATE INCORPORATING ANTIOXIDANT AND ZMBI

Formula

	Parts
Smoked sheet	100.0
FEF black	50.0
Zinc oxide	2.0
Stearic acid	2.0
TMT	1.5
Tellurium	3.0
ZEDC	3.0
MBTS	0.5
Flectol H	2.0
ZMBI	2.0

Cure: 30 minutes @ 140°C.

Aging, days at 100°C.	TS	EB	M100	CS
0	2520	530	210	—
14	1890	340	380	86
28	1720	340	470	94
56	710	200	340	98

TABLE VIII—EFFECT OF FILLERS ON AGING OF TMT/TELLURIUM VULCANIZATES

Formula

	Parts
Smoked sheet	100.0
Zinc oxide	2.0
Stearic acid	2.0
TMT	1.5
ZEDC	3.0
Tellurium	3.0
MBTS	0.5
Flectol H	2.0
ZMBI	2.0
Filler	50.0

Cure: 30 minutes @ 140°C.

	Aging, days at 100°C.	Filler HAF	Filler FEF	Filler ZnO/FEF
TS	0	2620	2520	2540
	14	2340	1890	2320
	28	1690	1720	2080
	56	480	710	950
EB	0	535	530	620
	14	380	340	490
	28	355	340	500
	56	130	200	370
M100	0	230	210	130
	14	410	380	190
	28	400	470	190
	56	440	340	190
M300	0	1120	1150	550
	14	1920	1710	900
	28	1510	1550	840
	56	—	—	740
CS	14	83	86	93
	28	90	94	100
	56	90	98	100

elongation values of 1440 psi and 585% for the ZMBI compound compared with 340 psi and 375% for the dual antioxidant compound.

The aging of the analogous FEF black stock based on the ZMBI protective system is excellent; the properties are given in the Table VII. Compared with the best tensile-retaining stocks given by the TMT/zinc oxide cure discussed earlier (Table VI), this shows, after 56 days at 100°C., similar tensile retention, better elongation retention and inferior compression set.

Effects of Fillers. In filler reinforced compounds, it is important to know the effect of the type of filler upon the heat aging properties of the stocks. A number of comparisons have been made with various vulcanizing systems based on TMT and with filler loadings of 50 phr. Table VIII gives results for one curing system; these are typical and the following observations are found to be generally applicable.

If FEF black is taken as control, a 1 to 1 FEF black and zinc oxide loading gives lower initial hardness and modulus, much higher extensibility and, after 56 days aging at 100°C., equal tensile and superior elongation retention, greater constancy of modulus and worse compression set. A HAF black stock compared with the same control showed after aging somewhat inferior tensile and elongation retention, similar modulus rise, but better compression set.

The aging of some of the above compounds at 125°C. has been the subject of a limited investigation. The results are typified by Table IX which shows the behavior of a TMT/zinc oxide vulcanizate, reinforced with FEF black and incorporating all protective agents. Rubbery properties are seen to be retained for more than one week at 125°C.

Vulcanization with Thiuram Disulfides Other Than TMT. Compounds vulcanized with equivalent concentrations of tetraethyl, tetrabutyl, tetrabenzyl and dipentamethylene thiuram disulfides have been found to have heat aging resistance similar in respect to tensile and extensibility retention to those based on TMT in both unprotected and fully protected formulations. Slight differences between the various vulcanizing agents are found for variation of modulus with aging, but in respect of compression set at 100°C. TMT is clearly the best. The interim conclusion of this current work is that no advantage comes from the use of other thiuram disulfides in place of TMT.

Sulfurless Thiuram Tetrasulfide Vulcanization. Dipentamethylenethiuram tetrasulfide (DPTT) is known as a vulcanizing agent for rubber. Compounds based on this material do not have heat aging properties as good as TMT vulcanizates, but are of interest in that they are much faster vulcanizing. It has been found that such stocks are afforded protection both by dithiocarbamates and by the use of ZMBI in association with an antioxidant. There is thus the possibility of preparing low temperature curing compounds with good heat aging characteristics. A comparison of such a compound cured one hour at 100°C. with a sulfur/accelerator compound shows a clear advantage for the former in respect to heat aging resistance (Table X). It is to be expected that compounds of this type will be of value for the production of both dry rubber and latex goods by hot air, hot water and low pressure steam vulcanization.

TABLE IX—AGING OF TMT VULCANIZATES AT 125°C.

Formula

	Parts
Smoked sheet	100
Zinc oxide	2
FEF black	50
TMT	3
ZBDC	3
Flectol H	2
ZMBI	2
Stearic acid	2

Cure: 60 minutes @ 140°C.

Aging, days at 125°C.	TS	EB	M100
0	3240	440	260
7	1860	260	260
14	1070	180	240

TABLE X—AGING OF HEAT-RESISTANT STOCKS CURED AT 100°C.

Formula	1	2
Smoked sheet	100	100
Zinc oxide	5	1
ZBDC	2	—
Stearic acid	1	1
DPTT	1	—
Sulfur	—	1
ZEDC	—	1
Flectol H	2	2
ZMBI	2	2
Cure at 100°C., minutes	60	120

	Aging, days at 100°C.	Formula 1	Formula 2
TS	0	3000	2220
	7	1310	230
	14	500	160
EB	0	790	780
	7	520	280
	14	380	210
M300	0	170	170
	7	260	—
	14	260	—

Peroxide Vulcanization

The vulcanization of rubber by organic peroxides has been the subject of renewed interest with the availability of dicumyl peroxide (DCP). This peroxide has been examined in both natural rubber *(14)* and acrylonitrile rubber *(15)*, and gives vulcanizates comparable in quality to those attained by sulfur cures. DCP vulcanizates of natural rubber have been shown *(14)* to exhibit good resistance to aging at 70°C.

TABLE XI—AGING OF BLACK REINFORCED DICUMYL PEROXIDE STOCKS AT 100°C.

Formula

	Parts
Smoked sheet	100
FEF black	50
Dicumyl peroxide	3
Lime (if indicated by Code L)	2
MTBZ (if indicated by Code D)	2
Flectol H (if indicated by Code A)	2
ZMBI (if indicated by Code M)	3

Cure: 60 minutes @ 140°C.

	Aging, days at 100°C.		MADL	MAD	MAL	MDL	ADL
TS	0	3580	2530	2780	2690	3090	3370
	14	270	2280	2000	1720	1090	1480
	28	E	1420	330	460	E	670
EB	0	310	350	460	380	330	310
	14	185	310	310	330	260	235
	28	E	245	110	120	E	190
M100	0	460	380	210	230	380	400
	14	90	310	360	190	310	370
	28	E	370	310	360	E	280
CS	14	50	68	75	52	53	60
	28	55	78	81	57	54	67

TABLE XII—AGING OF BLACK REINFORCED DICUMYL PEROXIDE CURED STOCKS AT 125°C.

Formula: See Table XI
Cure: 60 minutes @ 140°C.

	Aging, days at 125°C.	MADL	MAD	MAL	MDL	ADL
TS	0	3400	2530	2780	2690	3090	3370
	3	280	2050	1800	1640	410	1680
	7	E	1600	1210	930	E	1180
	14	E	950	E	130	E	240
EB	0	305	350	460	380	330	310
	3	300	370	335	360	280	320
	7	E	345	270	345	E	310
	14	E	230	S	60	E	170
M100	0	400	380	210	230	380	400
	3	40	210	240	160	100	170
	7	E	230	210	130	E	140
	14	E	219	E	—	E	100

in air, but aging at higher temperatures is not good (Tables XI and XII, first columns).

High temperature stress relaxation measurements have shown *(5)* that peroxide vulcanizates of natural rubber are, like TMT vulcanizates, protected against degradation by dithiocarbamates. Earlier technological work *(14)* on aging at 70°C. indicated that this was improved when lime was included in the vulcanizing formula and also by the use of antioxidants chosen so as to avoid undue cure inhibition.

The aging at 100°C. and 125°C. of DCP black loaded vulcanizates, both without protection and with the addition of ZMDC, lime, antioxidant (Flectol H) and ZMBI has been examined with the results shown in Tables XI and XII. It is seen that the combination of protective agents is very effective. Experiments to investigate the separate protective action of each of the four agents have not produced concrete evidence of activity in all cases, but it is clear from Tables XI and XII that synergistic protection arises in the simultaneous presence of all four, since elimination of any one component leads to inferior aging performance.

It should be noted that this DCP vulcanizate is at least equal to the best TMT vulcanizates when aged at 125°C. An important additional advantage of this fully protected peroxide vulcanizate is that the edges of moldings in the flash region are completely free from the excessive degradation and stickiness commonly found with this vulcanizing system.

Compounds for Specific Service Conditions

It has been pointed out earlier that some additives improve the aged values of certain properties and impair the aged values of others. A typical case is ZMBI the use of which gives better aged tensile strength but worse compression set. In specifying a formulation it is therefore important to consider the service requirements of the product for which it is intended. A conveyor belt cover requires maximum tensile and extensibility retention but compression set

TABLE XIII—FORMULAS OF REPRESENTATIVE NATURAL AND SYNTHETIC RUBBER COMPOUNDS

Natural Rubber Compounds

Formula	(1)	(2)	(3)	(4)
Smoked sheet	100.0	100	100	100
Zinc oxide	25.0	2	2	—
Stearic acid	2.0	2	2	—
TMT	1.5	3	3	—
Tellurium	3.0	—	—	—
Dicumyl peroxide	—	—	—	3
ZMDC	—	—	—	3
ZEDC	3.0	—	—	—
ZBDC	—	—	3	—
MBTS	0.5	—	—	—
Lime	—	—	—	2
Flectol H	2.0	2	2	2
ZMBI	2.0	—	2	2
Agerite White	—	1	—	—
FEF black	25.0	50	50	50
Cure, minutes @ 140°C.	30.0	60	60	60

Synthetic Rubber Compounds

Formula	(5)	(6)	(7)
Synthetic rubber	100.0*	100.0**	100.0***
Stearic acid	2.0	0.5	—
Zinc oxide	3.0	10.0	10.0
Magnesium oxide	—	4.0	—
TMT	3.0	—	—
Dibenzoyl quinone dioxime	—	—	6.0
Sulfur	—	—	1.5
MBTS	1.0	—	4.0
NA-22	—	1.0	—
PBN	1.0	1.0	—
Aranox	—	2.0	—
Flectol H	—	—	1.5
FEF black	50.0	30.0	50.0
Process oil	4.5	5.0	—
Cure, minutes @ 153°C.	30.0	15.0	60.0

*Styrene rubber (Krylene); **Neoprene WRT; ***Butyl rubber (Polysar 400).

TABLE XIV—EFFECTS OF AGING NATURAL AND SYNTHETIC RUBBERS

Formulas: See Table XIII

Aging at 100°C.

Formula		(1)	(2)	(3)	(4)	(5)	(6)	(7)
Type	Aging, days	NR	NR	NR	NR	Styrene Rubber	Neoprene	Butyl Rubber
TS	0	2540	3060	2880	2530	2440	2900	1390
	28	2080	930	1920	1420	2760	2360	1320
	56	950	E	1010	E	2290	2240	1380
EB	0	620	485	470	350	630	365	445
	28	500	285	285	245	300	240	280
	56	370	E	140	E	180	140	230
M100	0	130	270	240	380	300	470	440
	28	190	170	530	370	770	1070	680
	56	190	—	630	—	1350	1620	780
CS	28	Poor	56	75	78	76	56	88
	56	Poor	65	81	86	88	67	95

Aging at 125°C.

Formula		(3)	(4)	(6)	(7)
Type	Aging, days	NR	NR	Neoprene	Butyl Rubber
TS	0	3240	2540	2820	1310
	7	1860	1590	2600	1120
	14	1070	950	2640	1100
EB	0	440	350	395	425
	7	260	345	245	245
	14	180	230	105	260
M100	0	260	380	330	360
	7	260	230	970	450
	14	240	210	2490	430

is of lesser importance; a seal or gasket on the other hand requires low compression set while retention of strength is less vital.

Such considerations may also govern the choice of polymer. Where constancy of modulus is of great importance, as in mechanical mountings and couplings, natural rubber compounds are generally preferable. Table XIII gives the formulas and Table XIV illustrates the range of properties attainable in various natural rubber formulations: No. 1 has best retention of strength and extensibility and good stability of modulus on aging at 100°C.; No. 2 has minimum aged compression set; No. 3 is a compromise stock with a reasonable level of performance in both respects; and No. 3 or No. 4 are indicated for good aging at 125°C. The formulas and properties of representative synthetic rubber compounds, chosen from the respective manufacturers' recommendations, are also given in Tables XIII and XIV.

These data show that if he is required to design a compound for service in the temperature range 100-125°C., the compounder should give serious consideration to the good performance of correctly formulated natural rubber compounds, which is decidedly in advance of what is commonly believed.

ACKNOWLEDGMENT

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How to get more information from

Readings of Rotational Viscometers

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THE ROTATIONAL viscometer gives more information about viscous properties of fluids than is usually apparent. Aside from providing a value for comparing viscosities directly, the instrument affords a quantitative measure of structure (or of non-Newtonian behavior) in the form of a simple ratio of apparent viscosities. Treatment of the data is based on an empirical mathematical relation between apparent viscosity and viscometer speed, and is concerned with three indexes: (a) the apparent viscosity measured at one specified speed; (b) the ratio of apparent viscosities over a ten-fold speed range, and (c) the calculated one-revolution per minute apparent viscosity. Items (a) and (b) together, (a) and (c) together, or (b) and (c) together express all apparent viscosities for a sample in the speed range of the viscometer. All of the data reported in this article were obtained with four-speed Brookfield viscometers.

Indexes

Apparent Viscosity, V. A non-Newtonian fluid does not show a characteristic viscosity over a range of test conditions. Instead, only an apparent viscosity can be measured, and its value depends on the conditions of the test. These conditions must be standardized, e.g., with regard to the extent of premixing of the sample prior to test, temperature, instrument speed, and the bob or spindle used.

Viscosity Ratio. The ratio of apparent viscosities measured at different viscometer speeds is a measure of deviation from Newtonian behavior. It is unity for Newtonian fluids, greater than one for pseudoplastic liquids, and less than one for dilatant liquids. Most of the non-Newtonian liquids appear to be pseudoplastic. With such liquids, the graphs of logarithm (torque) vs. logarithm (viscometer speed) and logarithm (apparent viscosity) vs. logarithm (viscometer speed) are straight lines. The slope is positive with torque and negative with apparent viscosity. In the Appendix the viscosity ratio is shown to be related to the logarithmic slope by the simple relation

$$a = -\log \frac{V_x}{V_{10x}}, \qquad (1)$$

where a is the slope of the logarithm (apparent viscosity) vs. logarithm (speed) line, and V_x and V_{10x} are apparent viscosities measured at speeds of x and 10x, respectively. The ratio of apparent viscosities measured over a ten-fold speed range is preferred with the Brookfield viscometer because it is obtained simply by multiplying by ten the ratio of scale readings obtained with a given spindle (cf. Appendix). Some investigators have labeled this ratio "thixotropic index," but this term is not consistent with the concept of the thixotropic loop.

One-Revolution-Per-Minute Apparent Viscosity, b. This parameter is the computed apparent viscosity at an instrument speed of one rpm, and its logarithm is the zero intercept of the logarithm (apparent viscosity) vs. logarithm (speed) graph. The parameter b and either the logarithmic slope, a, or one apparent viscosity, V, together express all values of apparent viscosity in the range of the four-speed Brookfield viscometer, and to some extent beyond that range so that the data can be extrapolated to some degree.

TABLE I—COMPARISON OF APPARENT VISCOSITIES OF COMPETITIVE AQUEOUS ACCELERATOR DISPERSIONS

Viscometer Speed, rpm	2	4	10	20
	Apparent Viscosity, Centipoises			
Supplier A	7050	3825	1720	965
Supplier B	3000	2500	1780	1380

Utility of Indexes

Apparent Viscosity. By itself, the apparent viscosity measured under only one set of test conditions is of relatively little value with non-Newtonian fluids. When the plots of apparent viscosity vs. instrument speed for two liquids cross, one of them will be considered either less, equally, or more viscous, depending on which speed is chosen. A single speed is often

TABLE II—COMPARISON OF LOGARITHMIC SLOPES OBTAINED DIRECTLY FROM APPARENT VISCOSITIES WITH THOSE BASED ON VISCOSITY RATIOS

Item No.	a log slope*	—log ratio**	Difference		Composition	Ref.
1	—.611	—.613	.002,	0.3%	Color coating for paper, aqueous dispersion	1a
2	—.645	—.643	.002,	0.3%	Clay slip, 66.5% solids	1b
3	—.219	—.225	.006,	2.7%	Natural rubber latex compounds	2
4	—.246	—.258	.012,	4.9%		
5	—.275	—.274	.001,	0.4%		
6	—.258	—.260	.002,	0.75%		
7	—.612	—.609	.003,	0.5%	Styrene rubber copolymer latex compounds	2
8	—.577	—.573	.004,	0.7%		
9	—.583	—.581	.002,	0.3%		
10	—.780	—.767	.013,	1.7%		
11	—.545	—.544	.001,	0.2%		
12	—.880	—.875	.005,	0.6%		
13	—.864	—.861	.003,	0.3%		
14	—.878	—.874	.004,	0.5%		
15	—.876	—.871	.005,	0.6%		
16	—.677	—.677	0			
17	—.267	—.265	.002,	0.75%	50% Solids creamed Hevea latex	3
18	—.355	—.325	.030,	8.4%	55% Solids creamed Hevea latex	
19	—.400	—.398	.002,	0.5%	60% Solids creamed Hevea latex	
20	—.518	—.532	.014,	2.7%	67.3% Solids creamed Hevea latex	
21	—.242	—.258	.016,	6.6%	61.5% Solids centrifuged Hevea latex	
22	—.684	—.692	.008,	1.2%	Spindle 3	2
23	—.674	—.673	.001,	0.15%	Spindle 4	
24	—.660	—.659	.001,	0.15%	Spindle 5	
25	—.674	—.669	.005,	0.7%	Spindle 6	
					Latex composition, 4000 cp. apparent viscosity at 20 rpm	
26	—.923	—.901	.022,	2.4%	Spindle 3	2
27	—.912	—.912	0		Spindle 4	
28	—.913	—.910	.003,	0.3%	Spindle 5	
29	—.905	—.903	.002,	0.2%	Spindle 6	
					Aqueous accelerator dispersion, 2400 cp. apparent viscosity at 20 rpm	
30	—.253	—.257	.004,	1.6%	Spindle 1	2
31	—.278	—.273	.005,	1.8%	Spindle 2	
					Aqueous accelerator dispersion, 375 cp. apparent viscosity at 20 rpm	
32	0	0	0		0% Cab-O-Sil in polyester resin	4
33	—.635	—.637	.002,	0.3%	2% Cab-O-Sil in polyester resin	
34	—.732	—.741	.009,	1.2%	3% Cab-O-Sil in polyester resin	
35	—.781	—.784	.003,	0.4%	4% Cab-O-Sil in polyester resin	
36	—.858	—.859	.001,	0.1%	5% Cab-O-Sil in polyester resin	
37	—.891	—.864	.027,	3.0%	6% Cab-O-Sil in polyester resin	
38	—.098	—.083	.015,	15 %	Polyvinylchloride resin plastisols	5
39	—.149	—.144	.005,	3.4%		
40	—.112	—.108	.004,	3.6%		
41	—.098	—.088	.010,	10 %		
42	—.221	—.217	.004,	1.8%		
43	—.383	—.390	.007,	1.8%		

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*Based on four apparent viscosity values; **Based on ratio of two apparent viscosities measured over a ten-fold speed range.

specified for control or acceptance tests, and two different fluids could show the same apparent viscosity at that speed. They would then superficially appear to have similar flow properties. Yet, when tested under other conditions these samples could show substantial differences. This is illustrated by the data in Table I for aqueous accelerator dispersions. Here, material "A" appears more viscous at 2 and 4 rpm's; the 10-rpm results differ only by 3.9%; and at 20 rpm, material "A" appears less viscous.

Therefore, one apparent viscosity value alone is inadequate for characterizing viscous properties of

TABLE III—COMPARISON OF LATEX THICKENERS

Thickener	V_{20}, cp.	V_2/V_{20}	$-\log (V_2/V_{20}) = a$
Methocel 400	202	2.63	—.420
Casein	434	5.78	—.762
Acrysol GS	1845	6.13	—.788
Modicol VD	1850	6.84	—.835
Alcogum	3105	6.80	—.833

non-Newtonian fluids, and measurements at two or more speeds must be reported. Alternatively, the use of one apparent viscosity together with the viscosity ratio is preferred because the latter is correlated with a more fundamental property, namely, the logarithmic slope.

Viscosity Ratio and Logarithmic Slope. These are related by equation (1), which is confirmed experimentally in Table II. The viscosity ratio (correspondingly, the logarithmic slope) cannot be correlated with apparent viscosity at a single speed. For this reason, it measures some property which the latter does not, and consequently could be of value, along with the apparent viscosity, in correlating flow behavior of fluids in plant and laboratory operations.

Frequently, a higher viscosity liquid exhibits a higher viscosity ratio, but this is not generally true. For instance, a 4000 centipoise (at 20 rpm) latex composition has a viscosity ratio of about 4.7 ($a = -.67$), while an accelerator dispersion has a lower viscosity, 2400 centipoises (at 20 rpm), and a considerably higher viscosity ratio of 8.1 ($a = -.91$) (cf. Table II, items 22-29).

This is seen also in a comparison of latex thickeners, Table III, where the compositions differ only in the nature of added thickener. Change in apparent viscosity of a mixture on standing may or may not correspond to the change in viscosity ratio, as illustrated in Table IV. Item 1 shows the apparent viscosity, V_{20}, to pass through a minimum in 36 days while a, the logarithmic slope, shows a 21-day minimum.

In item 2 the V_{20} passes through a maximum in seven days, and the a in 14. In item 3, although the apparent viscosity drops continuously during the 1 to 56 day storage interval, the a value reaches a minimum on the twenty-eighth day and rises between that time and the fifty-sixth day. The compositions in Table IV are latex compounds and differ only in the chemical nature of the accelerator.

One-Revolution-Per-Minute Apparent Viscosity. Referring to the equations

$$V = bx^a \tag{2}$$

and

$$\log V = \log b + a \log x \tag{3}$$

the one rpm apparent viscosity parameter, b, is seen to be a function of apparent viscosity and the logarithmic slope at a given instrument speed:

$$b = \frac{V}{x^a}. \tag{4}$$

When a and b are known, the apparent viscosity corresponding to a particular speed can be calculated, thereby allowing interpolation and extrapolation. For example, a sample tested in a 2 to 20 rpm Brookfield viscometer has $a = -.6392$ and $b = 12{,}000$ ($V_2 = 7700$ cp. and $V_{20} = 1770$ cp.). The equation

$$V = 12{,}000\ X^{-.6392} \tag{5}$$

predicts apparent viscosities of 1365 cp. at 30 rpm and 875 cp. at 60 rpm. Extrapolated values are subject to error and measurements should be made with higher-speed instruments to determine how far extrapolations can be satisfactorily carried out.

Discussion

Test of the Log-Log Relation. Data selected at random were examined to determine how closely the relation holds, as expressed by equation 2 or 3. In the forty comparisons of a variety of compositions, shown in Table V, the difference between calculated and observed viscosity values ranged from zero to six per cent, with an average (median) value of two per cent.

Test of the Logarithmic Slope (a) and Viscosity Ratio Relation (cf. Equation 1). In the forty-three comparisons shown in Table II, differences between

TABLE IV—CHANGE IN APPARENT VISCOSITY AND LOGARITHMIC SLOPE ON ROOM TEMPERATURE STORAGE (LATEX COMPOUNDS)

Item No.		Time, days 0	1	7	14	21	28	36	43	56
1	V_{20}	2500	2460	1710	1025	860	825	805	845	895
	a	—.609	—.620	—.530	—.508	—.480	—.481	—.496	—.504	—.532
2	V_{20}	2460	2775	2925	2750	1950	—	—	—	840
	a	—.581	—.625	—.714	—.728	—.640	—	—	—	—.500
3	V_{20}	3150	3250	2930	2255	1560	1495	1160	1125	1065
	a	—.861	—.887	—.883	—.829	—.720	—.699	—.715	—.725	—.730

TABLE V—TEST OF THE LOG (APPARENT VISCOSITY) VERSUS LOG (VISCOMETER SPEED) RELATION

Table No. 2, Item No.							a	log b
1	Speed, rpm		10	20	50	100		
	Apparent Viscosity, Cp.	Observed	892	542	312	217	—.6107	3.5448
		Calculated	859	563	322	211		
		Difference	—33	+21	+10	—6		
			—3.7%	+3.9%	+3.2%	—2.8%		
3	Speed, rpm		2	4	10	20		
	Apparent Viscosity, Cp.	Observed	375	318	263	224	—.2190	2.6371
		Calculated	373	320	262	225		
		Difference	—2	+2	—1	+1		
			—.5%	+.6%	—.4%	+.4%		
7	Speed, rpm		2	4	10	20		
	Apparent Viscosity, Cp.	Observed	10150	7250	4100	2500	—.6124	4.2099
		Calculated	10610	6940	3960	2590		
		Difference	+460	—310	—140	+90		
			+4.5%	—4.3%	—3.4%	+3.6%		
20 (Spindle #2)	Speed, rpm		6	12	30	60		
	Apparent Viscosity, Cp.	Observed	1370	862	552	404	—.5178	3.5170
		Calculated	1288	908	570	395		
		Difference	—82	+46	+18	—9		
			—6.0%	+5.3%	+3.3%	—2.2%		
20 (Spindle #3)	Speed, rpm		6	12	30	60		
	Apparent Viscosity, Cp.	Observed	1500	1000	600	470	—.5193	3.5702
		Calculated	1462	1023	636	443		
		Difference	—38	+23	+36	—27		
			—2.5%	+2.3%	+6.0%	—5.7%		
22	Speed, rpm		2	4	10	20		
	Apparent Viscosity, Cp.	Observed	18700	10850	5900	3800	—.6842	4.4626
		Calculated	18060	11240	6000	3740		
		Difference	—640	+390	+100	—60		
			—3.4%	+3.6%	+1.7%	—1.6%		
26	Speed, rpm		2	4	10	20		
	Apparent Viscosity, Cp.	Observed	17900	9625	4110	2150	—.9229	4.5349
		Calculated	18100	9530	4090	2160		
		Difference	+200	—95	—20	+10		
			+1.1%	—1.0%	—.5%	+.5%		
30	Speed, rpm		2	4	10	20		
	Apparent Viscosity, Cp.	Observed	633	510	408	350	—.2534	2.8689
		Calculated	620	520	413	346		
		Difference	—13	+10	+5	—4		
			—2.1%	+2.0%	+1.2%	—1.1%		
36	Speed, rpm		2	4	10	20		
	Apparent Viscosity, Cp.	Observed	1300	690	315	180	—.8578	3.3637
		Calculated	1275	704	321	177		
		Difference	—25	+14	+6	—3		
			—1.9%	+2.0%	+1.9%	—1.7%		
43	Speed, rpm		6	12	30	60		
	Apparent Viscosity, Cp.	Observed	243	186	133	99	—.3831	2.6833
		Calculated	243	186	131	100.5		
		Difference	0	0	—2	+1.5		
			—	—	—1.5%	+1.5%		

TABLE VI—COMPARISON OF VISCOMETER SPINDLES

Speed (rpm)	2	4	10	20			
Spindle No.	Apparent Viscosity				a	log b	Material
3	18700	10850	5900	3800	—.6842	4.4626	Latex compound
4	20800	13500	7260	4420	—.6739	4.0426	
5	17500	11200	6100	3840	—.6600	3.9683	
6	17500	11250	6000	3750	—.6739	3.9656	
Spread	3300	2650	1360	670	.0242	.4970	
	17.7%	22.6%	21.5%	17.0%	3.6%	12.1%	
Speed (rpm)	6	12	30	60			
2	1370	862	552	404	—.5178	3.5170	67.3% Solids
3	1500	1000	600	470	—.5193	3.5702	creamed Hevea latex
Spread	130	138	48	66	.0015	.0532	
	9.1%	14.1%	8.3%	15.1%	0.3%	1.5%	
Speed (rpm)	2	4	10	20			
3	17900	9625	4110	2150	—.9229	4.5349	50% Solids
4	19500	10450	4520	2390	—.9125	4.5666	aqueous
5	19500	10500	4520	2400	—.9127	4.5677	accelerator
6	21000	11500	5000	2625	—.9046	4.5999	dispersion, higher viscosity
Spread	3100	1875	890	475	.0183	.0650	
	15.9%	17.8%	19.6%	19.9%	2.0%	1.4%	
Speed (rpm)	2	4	10	20			
1	633	510	408	350	—.2534	2.8689	50% Solids
2	750	600	460	400	—.2778	2.9515	aqueous accelerator
Spread	117	90	52	50	.0244	.0826	dispersion,
	16.9%	16.2%	12.0%	13.3%	9.2%	2.8%	lower viscosity

a determined in two ways ranged between zero and fifteen per cent, with a median difference of 0.6%. The large percentage differences were relatively few—only four were above 5%—and the two above 10% were based on small values of a (−.098).

Effect of Spindle. Use of different spindles led to differences but the data were insufficient to establish a trend (cf. Table VI). It would be expected that the higher peripheral velocity of a larger spindle would cause a lower apparent viscosity because of thixotropy. Such a conclusion cannot be drawn from these limited data, however. It is possible that random variations were of sufficient magnitude to mask such a trend.

It is interesting to observe the much smaller variations in the parameters a and log b than in the apparent viscosities. It is evident that some variables can have a marked effect on the apparent viscosities, yet affect the logarithmic slope, a, and the intercept, log b, much less, percentagewise.

Correlation of the Indexes with Variables. An example is the case where both the apparent viscosity (alternatively, the log b intercept) and the logarithmic slope, a, showed correlation with concentration of a filler in a resinous composition. As shown in Figures 1 and 2, both the logarithm of the apparent viscosity and log b were linear with concentration of Cab-O-Sil; also, logarithmic slope, a, was proportional to the logarithm of the concentration over a similar range. Since different mathematical functions of concentration of the filler are involved, apparently different properties are compared. If these relations are general, i.e., if log V or log b is usually proportional to concentration of filler and a is usually proportional to the logarithm of concentration, this correlation technique would be of value in characterizing fillers used in liquid systems. Similarly, other variables could be studied, such as chemical nature of the additive, storage at various temperatures, and solids content of the liquid (cf. Table II, items 17-21).

The technologist has a choice of viscometers ranging in speed from less than one to several hundred revolutions per minute, and has the problem of deciding which speed range is best. In many applications, such as the dipping of latex articles, the rate of shear is usually low. Therefore, in such cases, it is likely that a lower speed instrument would be more useful.

In other cases, high speed viscometers may be preferred. The latter, operating in the range of over 200 rpm, can be used to determine the limiting coefficient of viscosity and the yield point when the shearing stress is proportional to the shearing strain. The a and b parameters apply to the lower speed instruments when the log-log relation is observed, but do not apply to the high speed viscometers in regions where the torque is linear with respect to speed.

Summary and Conclusions

It is recommended that when a rotational viscometer of the Brookfield type is used to measure viscosity of non-Newtonian liquids at speeds under 200 rpm, two values be reported: (a) apparent viscosity at a stated speed (along with the spindle number), and (b) the ratio of apparent viscosities measured over a ten-fold interval, with the lower-speed apparent viscosity as the numerator.

A viscosity ratio of unity signifies a Newtonian liquid, while deviation from unity is a quantitative measure of non-Newtonian behavior or structure in the liquid.

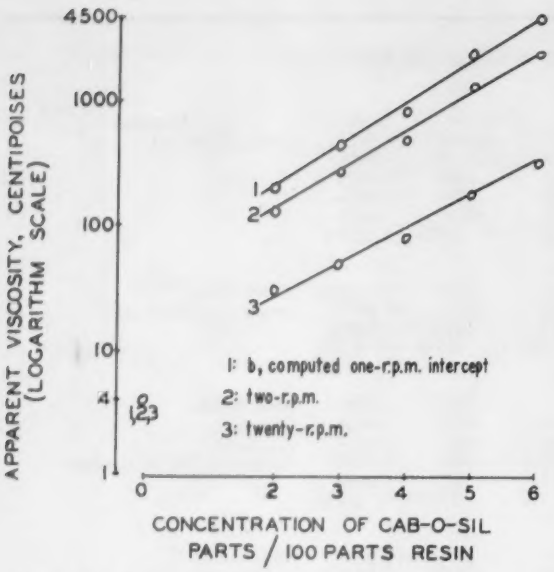

FIG. 1—Relation between apparent viscosity and concentration of filler.

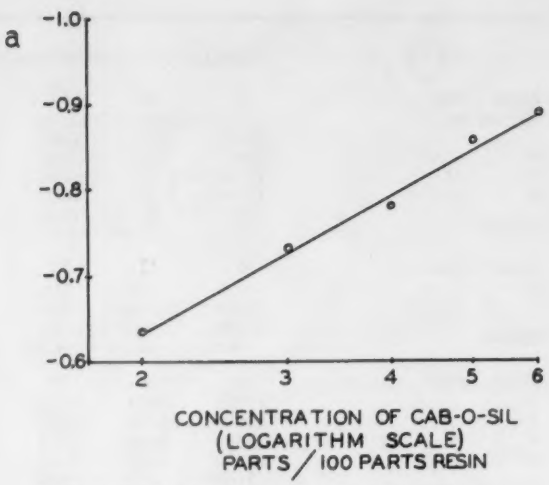

FIG. 2—Relation between a and concentration of filler.

For pseudoplastic liquids, apparent viscosity is related to viscometer speed, in speeds below about 200 rpm, by the equations

$$V = bx^a \tag{2}$$

and

$$\log V = \log b + a \log x, \tag{3}$$

where V is apparent viscosity, a is an empirical constant representing the exponent (or the slope of the log-log graph), b is an empirical constant representing the computed one rpm viscosity (log b is the zero-log intercept on the log-log graph), and x is the viscometer speed.

In the forty comparisons shown in Table V, differences between calculated and observed apparent viscosities ranged from zero to six per cent with an average (median) difference of two per cent. Therefore, all apparent viscosities for a given sample in the speed range of the viscometer are conveniently expressed by the two parameters a and b, or by log V along with either a and b, in conjunction with the preceding equations.

The viscosity ratio is related to the exponent or logarithmic slope a according to the equation:

$$a = -\log_{10}\left(\frac{V_x}{V_{10x}}\right) \tag{6}$$

where V_x and V_{10x} are apparent viscosities measured over a ten-fold speed range, x signifying the lower speed. In 43 random comparisons the median difference between a and the negative logarithm of the viscosity ratio was only 0.6 per cent.

When different spindles of a Brookfield viscometer are used with a given sample, the parameters a and log b show a much smaller variation, percentagewise, than the apparent viscosities.

The parameter a appears to evaluate properties which the apparent viscosity does not. Therefore, it could be of value along with the apparent viscosity in correlations with flow properties, storage studies, filler loadings and other variables.

This technique allows interpolation, which is useful in comparing measurements made with other viscometers, also in evaluating the rate of dipping of forms in latex, in spreading operations, and in similar handling of latices, plastisols and organosols. Extrapolation beyond the range of an instrument's speeds is useful. However, the limits of such speed ranges must be determined before reliance can be placed on the extrapolated values.

Appendix

(1) Viscosity Ratio. The scale reading of the Brookfield instrument is a torque measurement. For example, full-scale torque on the RVF model is 7187 dyne-cm. (R. A. Minard, Brookfield Engineering Laboratories, personal communication, June 30, 1952), and a reading of 40 on the 100 scale signifies a torque of 0.40 × 7187 or 2875 dyne-cm. Viscosity is computed by multiplying the scale reading by a factor which is specified for a given spindle and speed. Inspection of the information supplied with the Brookfield viscometer shows the product of factor times speed to be a constant for a given spindle. Therefore, the ratio of viscosities over a ten-fold speed range is simply ten times the ratio of the scale readings:

$$\frac{V_x}{V_{10x}} = \frac{10R_x}{R_{10x}}$$

(2) Relation between Viscosity Ratio and Logarithmic Slope, a. When apparent viscosities measured over a ten-fold speed range are substituted in the equation $V = bx^a$, there results the relation

$$\frac{V_x}{V_{10x}} = \frac{b}{b}\left[\frac{x}{10x}\right]^a = \left[\frac{1}{10}\right]^a$$

and

$$\log\frac{V_x}{V_{10x}} = a \log\left[\frac{1}{10}\right] = -a.$$

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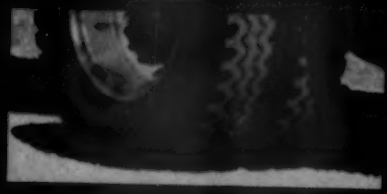

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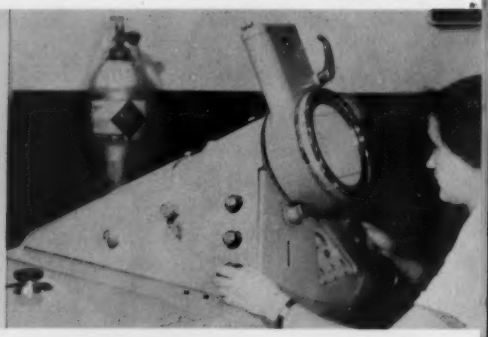

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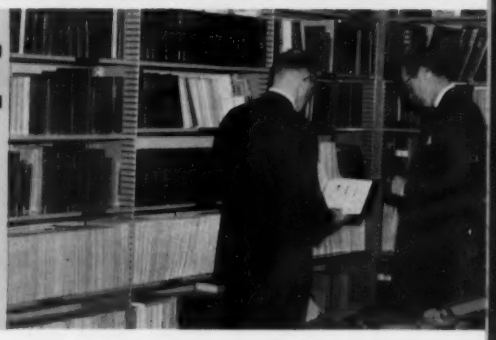

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STATEX®-B FF Fine Furnace
STATEX-M FEF Fast Extruding Furnace
STATEX-93 HMF High Modulus Furnace
STATEX-G GPF General Purpose Furnace
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EDITORIAL

Statistics: Fact or Fancy?

IN soliciting industry viewpoints for our annual Review and Preview of the Rubber Industry, which appears elsewhere in this issue, we have been impressed by the thought and the care which has gone into the preparation of individual statements. It is apparent that our contributors are not only thoroughly familiar with industry problems, but are cognizant of the general economy in which our industry operates.

The reader will note that these individual statements represent companies from all about the country. Moreover, the statements are representative of the individual segments of the industry and its suppliers. In preparing these individual expressions for print, however, we have been struck by a problem which presents itself each time this matter of gauging the future comes before us. The problem: A lack of definitive and accurate statistics for the rubber industry.

At the moment, there are basically two organizations which concern themselves with the issuance of rubber industry statistics. One is the Rubber Manufacturers Association and the other is the Chemical and Rubber Division of the Business and Defense Services Administration. Let us first state that both these organizations do yeoman's service in the preparation of facts and figures and what we say now in no way deprecates the excellence of their activities. The fact remains, however, that there is a serious lack insofar as the total statistical picture is concerned.

For example, the Bureau of the Census in its *Census of Manufacturers* provides excellent source material defining not only how much rubber is consumed, but where it goes and at what price. Unfortunately Census figures are frequently two, three and even four years behind.

Individual rubber companies often maintain their own statistical departments, frequently coupling these activities with their own market research. Many times, statistics issued by an individual company are at variance with figures issued by another company, and the problem is compounded.

If we take an individual case the matter becomes clearer. There are today no figures available detailing the latex foam rubber market. Of course, figures are quoted from time-to-time, but these usually represent the "educated guess." Now "educated guesses" are more often right than wrong, but still the problem remains.

If we take some large segment such as the transportation segment and attempt to follow through some statistical point we still have a confusing situation. Some define the transportation segment as that part of consumption representing tires, tubes and everything going into a given vehicle. With this definition, floor mats are included and maybe fan belts and so on. Others define the transportation segment as being tires and tubes—period. With these conflicting points of view it will be seen that the tracing of a pattern is not only difficult but almost impossible.

On the average, rubber industry statistics are far better than those for many other fields. However, the petroleum industry and the automobile industry seem to have a little bit more to offer in the completeness of available information.

What it comes down to is this: Is there not some way open to us to insure the accuracy and availability of statistical information to the rubber industry? We do not speak of those statistics which might reveal the competitive situation of an individual concern. We do speak of a total consumption breakdown showing how much rubber is consumed for what type of products—an up-to-date Census, so to speak.

How can we accomplish this aim? We would open several methods for discussion: One would include a governmental appropriation so that the activities of BDSA could be enlarged. Another approach would have a projected rubber industry research center devote some attention to this matter of statistics. Still another way to handle the matter could involve the employment of a market research organization. Many other methods will suggest themselves.

We do feel that the matter calls for further discussion and we would be pleased to hear from our readers.

RMA Predicts 13% Rise In 1959 U.S. Consumption

1.5 Million Ton Usage Seen For New Year

► A year end statement released by Ross R. Ormsby, president of the Rubber Manufacturers Association, said that on the basis of the quickened pace of production in the 1958 fourth quarter, the rubber manufacturing industry now looks forward to a 13 per cent gain in rubber consumption during 1959. Although 1958 figures are not all in, he said, it is indicated that consumption totaled about 1,330,000 long tons as compared with 1,500,000 long tons estimated for 1959.

According to Mr. Ormsby, manufacturers of consumer type rubber products generally did well last year, with estimated shipments of 59,500,000 replacement passenger tires setting a new record. Other segments of the industry, however, felt the impact of the 1957-58 business setback, notably, firms manufacturing original equipment automotive rubber products and industrial rubber products, he said. The rubber industry's recovery since April, 1958, has been quite as rapid as the decline prior to that month. All segments of the industry were confronted with the problem of constantly increasing production costs in 1958 and there are no indications that this problem will ease in 1959.

In addition to the 5 per cent increase in replacement passenger car tire shipments over 1957, two other categories showed increases. It was estimated that shipments of replacement truck-bus tires would exceed eight and a half million units in 1958, up 3 per cent from those of the preceding year, and that shipments of replacement farm tires would show a gain of more than 14 per cent. Table I shows 1957 and estimated 1958 figures for passenger, truck and farm tire shipments in the original equipment, replacement and export categories. In other areas, Mr. Ormsby said, 1958 shipments of rubber footwear would show a small gain over 1957, and major drug sundry items would come close to matching 1957 performance.

Referring to projected increases in rubber consumption in 1959, Mr. Ormsby said the industry felt no concern as to raw materials. "Free-world rubber producing capacity was increased by more than 350,000 long tons in 1958. Further planned expansions should increase the free-world's total new rubber producing capacity to more than 4,360,000 long tons a year by 1962—a 27 per cent increase in just five years. This would be roughly 580,000 long tons in excess of projected annual requirements of rubber manufacturers throughout the world," he said.

Synthetic Ratio Cited

Noting that most of this new capacity would be in the form of synthetic rubber producing facilities, Mr. Ormsby pointed out that synthetic rubbers are the preferred raw materials in the United States by a ratio of almost two to one. "In 1958, synthetic rubber accounted for 64 per cent of our total new rubber consumption," he said. Table II sets forth actual United States consumption figures for 1957 and estimated consumption for 1958 and 1959. Mr. Ormsby continued to say, "At the same time, the ratio of synthetic total new rubber consumption abroad has risen almost without interruption since World War II, and presently represents more than 25 per cent of total new rubber usage elsewhere in the free world."

Intensified research has added many new items to the list of more than 40,000 rubber products produced by non-tire segments of the rubber manufacturing industry, the RMA president said. Sales of these non-tire products accounted for more than half of the industry's total dollar volume in 1958. Notable among new and improved products listed were hose, belting, and packing and seals especially designed to meet "space age" requirements of both industry and military establishments for superior performance under extreme ranges in temperature.

Table I—Automotive and Farm Tire Shipments

	Passenger	*Truck*	*Farm*	*Total*
1957				
Original Equipment	32,722,589	4,039,020	1,640,414	38,402,023
Replacement	56,612,267	8,549,295	1,545,048	66,706,610
Export	888,333	842,476	94,475	1,825,284
	90,223,189	13,430,791	3,279,937	106,933,917
1958				
Original Equipment	22,300,000	3,345,000	1,715,000	27,360,000
Replacement	59,500,000	8,825,000	1,760,000	70,085,000
Export	700,000	630,000	100,000	1,430,000
	82,500,000	12,800,000	3,575,000	98,875,000

Table II—U. S. Rubber Consumption

(Long Tons)

	1957	1958	1959
Synthetic Rubber	926,000	854,000	975,000
Natural Rubber	539,000	476,000	525,000
Total New Rubber	1,465,000	1,330,000	1,500,000
Reclaimed Rubber	267,000	245,000	280,000

Chicago Group Hears Talks By Wendrow And Caprino

► The Chicago Rubber Group held its regular meeting on November 15, 1958, at the Furniture Club, Chicago, Ill., and was attended by 160 members. The meeting featured talks by B. R. Wendrow and J. C. Caprino. Mr. Wendrow, technical manager, U.S. Rubber Reclaiming Co., spoke on "Reclaiming of Silicone & Special Polymers" while Mr. Caprino, technical representative, Silicone Products Division, General Electric Co., spoke on "New Developments in Silicone Rubber Technology." Mr. Wendrow stated that silicone scrap may be reclaimed regardless of the state of cure of the scrap. The most uniform silicone reclaimed rubber is obtained from post-cured scrap, however good reclaim also can be prepared from lower states of cure. He explained that it is important to keep scrap segregated according to cure state, as different cure levels require different degrees of treatment. In their final applications, reclaims prepared from different states of cure give about the same physical properties.

Mr. Wendrow pointed out that blends of reclaim and virgin stock produce vulcanizates having physical properties close to those of the original stock providing the reclaim is held at 20 per cent content. Blends in excess of 20 per cent reclaim require additional curing agent in proportion to the amount of reclaim used. He concluded his discussion by stating that improvements in silicone reclaiming procedures have improved the potential of the reclaim in extrusion items, and that these improvements are physical in nature and are based on better milling procedures and the addition of straining through fine mesh screens.

Mr. Caprino, in his talk before the group, spoke of the new devolpments in silicone gums since 1954 and the improved properties that were expected to become available as additional new gums, such as nitriles, are introduced in the near future. He discussed the different products available through silicones and what silicone specifications have been issued since 1954. He dealt with the physical property improvements of silicones in addition to the processing improvements and innovations. He concluded with the statement that the most probable improvements for the future are stocks with better oil and fuel resistance combined with high strength.

Worthington Agent Appointed

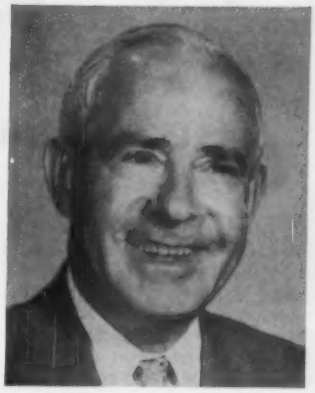
► Worthington Corp., Harrison, N. J., has appointed the Transportation Equipment Co., Inc., New Orleans, La., to handle the distribution of Truck Mixers and Big Mixers, manufactured at the company's Plainfield, N. J. plant, in the states of Louisiana and Mississippi.

Drogin Elected I.R.I. Fellow

► Dr. Isaac Drogin, who has been associated with the United Carbon Co. for the last 19 years, has been unanimously elected a Fellow of the British Institution of the Rubber Industry. Dr. Drogin is a graduate of the College of the City of New York, from which he received a B.S. degree in 1913. He received M.Sc. and Ph.D. degrees from the University of Pittsburgh in 1916 and 1921, respectively. From 1914 to 1921, he was a Fellow of the Mellon Institute of Industrial Research.

Having extensive experience in the rubber industry, Dr. Drogin was chief chemist for the J. M. Huber Corp. from 1929 to 1939. In 1939, he was named director of research for the United Carbon Co., Inc. He became vice-president of United Carbon Co., Inc., a subsidiary, in 1955 and also of United Rubber and Chemical Co., another subsidiary, in 1957.

Dr. Drogin is a member of the American Association for the Advancement of Sciences; American Chemical Society; American Institute of Chemists; American Society for Testing Materials and its Committees D-11 and D-24; Rubber Division, ACS; Chemists' Club (New York); Institution of the Rubber Industry (England); New York Academy of Sciences; West Virginia Academy of Science; Pi Lambda Phi Fraternity; and the Masons. He is the author of more than 20 publications dealing with carbon black and rubber technology. Dr. Drogin has the distinction of having presented a paper at the First, Second and Third Rubber Technology Conferences in London in 1938, 1948 and again in 1954.



Dr. Isaac Drogin

Heyden Newport Names Aude

► Heyden Newport Chemical Corp., New York, N. Y., has named Robert M. Aude as vice-president and general manager of its Heyden Chemical Division. Mr. Aude began his association with Heyden in 1953 as plant manager of the Fords, and later the Garfield, N. J. plants. In 1956, he was named director of sales planning and coordination. Mr. Aude was graduated from the University of Wisconsin with a B.S. degree in Chemistry. He is a member of the American Chemical Society, the American Institute of Chemical Engineers, Armed Forces Chemical Association, SOCMA, SAACI and Alpha Chi Sigma.

DuPont Price Reductions

► Elastomer Chemicals Department of E. I. du Pont de Nemours & Co., Inc., Wilmington, Del., has announced price reductions on two special isocyanate products. "Hylene M" organic isocyanate has been cut by 50c per pound, from $1.75 to $1.25, while "Hylene M-50", a solution used in adhesives manufacture, has been reduced from $1.00 per pound to 86c. Both prices apply to 55 gallon drums in less than carload lots.

Goodyear Tire Testing Machine

► Goodyear Tire & Rubber Co., Akron, Ohio, has announced that it is obtaining a machine that will go from a standing stop to 300 miles an hour in just 18 seconds. The machine, which cost $2 million, is a dynamometer and will be used by the company in the testing of airplane tires. The unit is being built by the Adamson United Co. and is expected to be in use by July, 1959. According to Goodyear, with the dynamometer an airplane experimental tire can be thoroughly checked for stability in jet age landings and take-offs. Testers can see on the dials, instruments and on recording tapes just exactly what a given tire will do under a given set of conditions.

N. Y. Rubber Buys Plant

► New York Rubber Corp., Beacon, N. Y., has purchased a new 70,000 square foot plant in Swainsboro, Ga., where the company will manufacture inflatable rubber life rafts and other inflatable rubber products. The 350 foot long and 200 foot wide plant will be modernized for the company's operations and modern lighting and ventilating equipment will be installed.

ASME Rubber and Plastics Division Holds Two-Day Meeting in New York

Three Technical Sessions Feature December Meeting

► Approximately 90 members attended each of the three technical sessions sponsored by the Rubber and Plastics Division of the American Society of Mechanical Engineers, which were held on December 3 and 4 at the Statler-Hilton Hotel, New York, N. Y., during the society's Annual Meeting.

A meeting of the General Committee was held on Wednesday noon, with R. W. Barber (St. Regis Paper), the retiring chairman, presiding. In opening this meeting, Mr. Barber stated that the revised by-laws of the division were in the final stage of preparation and would soon be ready for submission to headquarters for approval. Some discussion was then held on possible research activities to be sponsored by the division but it was agreed that this subject would have to be tabled for future action.

It was announced that Selby Skinner (Case Institute) and W. K. Taft (Olin Mathieson) had been appointed as members of the Executive Committee and that G. L. Bruggemeier (Firestone) had been obliged to resign from the committee due to new duty assignments by his company. The latter will, however, retain responsibility for the program for the June, 1959, meeting, which will feature a Symposium on Tire Cord. It was also announced that P. J. Larsen (Lord Manufacturing) has been named chairman of the Rubber Papers Committee and that Don Cornell (General Electric), an active member of the division, has been elected a member of the ASME Board of Technology.

Plans for Annual Meeting

Mr. Barber reported that plans were progressing on a suitable program for the 1959 Annual Meeting, which will be held in New York as usual, and that sessions will probably be devoted to plastic films and plastic pipes, respectively. A divisional conference is planned in Erie, Penna., for the Fall of 1960, and because of the time element involved the division will probably not participate in the annual meeting to be held in December of that year. In addition, it was reported that plans were coming along well for the participation of the division in the International Rubber Conference which will be held in the Fall of 1959. The division will sponsor a full day's program at this five-day meeting.

At the conclusion of the business session, R. D. Stiehler (National Bureau of Standards), who has served as secretary of the Division for the past year, took over as the 1958-59 chairman. His first official act was to present a rubber-and-plastic gavel and a certificate from Headquarters to Mr. Barber in appreciation for his past services.

The first technical session was held at 9:30 a.m. on Wednesday, December 3, with D. M. Alstadt (Lord Manufacturing) presiding, and R. F. Westover (Bell Telephone Laboratories) acting as vice-chairman. D. Richart, S. H. Richardson and C. F. Pitt (Bakelite) presented the first paper, which was entitled "Epoxy Resins and their Applications." The authors discussed epoxy resins and their applications with particular emphasis on adhesives, giving a brief description of the chemistry of resins, various materials available as curing agents, and properties of cured systems. Adhesion was also discussed from the standpoint of theory, types of adhesives and particular applications for epoxy adhesives.

"The Strength of Curved Glued Laminated Wood Timbers as Affected by Radius of Curvature and Lamination Thickness," was delivered by William J. Finnorn (Timber Engineering) and Andrew Rapavi (Bureau of Ships). The radius of curvature stressing wood to proportional limit and to rupture were determined for various thicknesses of white oak and several other woods. White oak beams of different lamination thicknesses were laminated to a 72 inch radius of curvature and tested for bending strength.

The paper "New Developments in Reinforcements" was delivered by W. E. Dirkes (Wright-Patterson Air Force Base). The author reviewed the currently available commercial materials and scarcely available laboratory developments for the reinforcements used in structural plastics. Glass fibers were compared to other forms of fibrous reinforcements, and glass flake characteristics were reviewed.

"Prediction of Load and Creep-Deflection in Beams and Eccentrically-Loaded Members," was discussed by Omar Sidebottom and Sangiah D. Harmarajan (University of Illinois). The paper gave a theoretical analysis by which the load and creep-deflection can be determined for beams and eccentrically-loaded members. Confirmation test data was also provided.

The next paper was entitled "Room Temperature Vulcanizing Silicone Rubber, A Versatile New Engineering Material", and was presented by R. Treat, Jr. (General Electric). Mr. Treat discussed a new group of silicone rubber compounds which cure at room temperature and which are now commercially available. According to the speaker, high temperature sealing, caulking, potting and encapsulating as well as tooling and model making are a few of the applications possible with the newly developed room temperature vulcanizing silicone rubber.

"Control of Flexural Strength of Glass Fiber Resin Laminates by Glass Surface Treatment and Theoretical Implications" by Nicholas M. Trivisonno (Goodrich Research Center), was also presented at this meeting.

Second Technical Session

The second technical session was held on Wednesday, December 3 at 2:30 p.m., with Bryce Maxwell (Princeton University) as chairman and R. J. Bourke (Monsanto) as vice-chairman. Richard E. Ely (Army Rocket & Guided Missile Agency) gave an address on "Some High-Speed Tensile Properties for Thermoplastics." Mr. Ely discussed the tensile properties for three thermoplastics for six decades of rate and several temperatures. He also gave strength and strain behavior and some elastic moduli.

"Designing with 'Delrin' Acetal Resin," was presented by Watson C. Warriner (DuPont). Mr. Warriner described "Delrin" acetal resin, a new thermoplastic engineering material, said to have a combination of properties not found in any other single material. The properties of this material were discussed and related to specific applications, with photographs, sample calculations and other data.

Kenneth H. Grim (Disogrin Industries) delivered a paper on "Applications of Solid Polyurethane." After a brief review of the basic processes involved in the fabrication of parts from this new material, the author described applications that have been made and used in industry. The method of preparing the raw material was discussed and physical descriptions and the case

histories of parts successfully made from solid polyurethane were treated.

"Review of Developments in Plastics Engineering 1957-1958," was discussed by R. I. Leininger and R. A. Clark (Battelle Memorial Institute). The authors described progress made in 1957 and 1958 in plastics as engineering materials of interest to mechanical engineers. New materials, their applications, and new applications for older materials were described. The authors also reviewed advances in the processing of plastics and the necessary equipment.

The last paper delivered at the second technical session was entitled "Polymers are Not Products in Plastics Fabrication," by James E. Tollar (Dow Chemical). Mr. Tollar stated that the plastics industry is an unusual industry which has enjoyed phenomenal growth. The keenness of current competition, he said, suggests a reflective consideration of the fundamentals of present day plastics fabrication. The author felt that it is possible that close scrutiny will lead to a greater awareness of the art, and still greater technological advances.

Last Technical Session

The last technical session of the meeting was devoted to the topic of "Design of Engineering Properties in Plastics", and was held at 9:30 a.m. on Thursday, December 4, with Edward G. Bobalek (Case Institute) as chairman and John J. O'Connor (Military Medical Supply Agency) as vice-chairman.

"Chemical Degradation and Mechanical Testing of Polyethylenes," was presented by J. Neil Henderson; Tito T. Serafini; Edward G. Bobalek; and J. Reid Shelton (Case Institute). The authors compared methods of accelerated oxidation of polyethylenes. Degradation was measured by mechanical testing, simpler indexes being inadequate. According to the authors, yield strength was particularly resistant to degradation.

Robert J. Gelin (Structural Fibers), Robert F. Toomey (Case Institute) and William M. Ellslager (Glidden) were the authors of a paper entitled "The Liaison Problem of the Translation of Laboratory Design Data Into Production Practice". This report covered the overall planning required for the design, testing and production of plastic articles meant to replace metal equipment used by the Military Medical Supply Agency.

The next paper was "Important Design Considerations for Reinforced Plastics," by Harry R. Nara (Case Institute). The objective of this paper was to review the physical properties of glass reinforced epoxy and polyester resins and to point out their relationship to design considerations. An attempt was made to point out some of the critical differences between design in metals and design in reinforced plastics, including fatigue, elastic stability and rigidity.

Other papers given at this session were "Molecular, Microscopic and Macroscopic Structural Data in the Design of Plastics Molding Compositions to Fit Service Specifications", by Robert M. Evans (Master Mechanics) and Edward G. Bobalek (Case Institute); and "Significance of Physical Test Methods in Interpreting Design Properties of Plastics," by Robert M. Evans (Master Mechanics) and S. M. Skinner (Case Institute). The session was closed by Donald H. Cornell (General Electric) with a discussion of "Summary of Papers Presented at Rubber and Plastics Sessions I, II, and III.

R. E. Allen

W. A. Smith

Precision Rubber Elects Officers

► Precision Rubber Products Corp., Dayton, Ohio, has announced the election of H. G. Taylor, founder and president of the company, as chairman of the board, R. E. Allen as president; and W. A. Smith as vice-president. Mr. Allen is a graduate of Massachusetts Institute of Technology and has been in the seal industry since 1931. He came to Precision in 1945 and was appointed vice-president in charge of all sales in 1949. Mr. Smith joined Precision in 1944 and in 1949 he was appointed vice-president in charge of production.

Increases Plant Capacity

► Mobay Chemical Co., Pittsburgh, Penna., has announced that construction which permits a 50 per cent increase in manufacturing capacity for tolylene diisocyanate chemicals has been completed at its New Martinsville, West Va. plant. According to Mobay, the new addition, coupled with multipurpose facilities completed in 1957, now provides what is thought to be the most complete and diversified single plant for the manufacture of basic urethane chemicals in the U. S.

Establishes New Firm

► W. E. McCormish, previously associated with L. Albert & Son, now the Bellanca Corp., has established the McCormish Co. at 418 Woodland Ave., Akron, Ohio, for the purchase and sale of rubber machinery.

Harshaw Develops Stabilizer

► Harshaw Chemical Co., Cleveland, Ohio, has announced the development of a liquid vinyl stabilizer, called "Stabilizer 6-V-2", for the control of materials performance variations in flexible vinyl compounds. According to the company, Stabilizer 6-V-2 has a high control as well as high mileage in heat and light stabilization. The small amount of 6-V-2 used in a typical flexible vinyl compound is enough to level out effects of non-uniformity from lot to lot, which may occur in supplies of resin, plasticizer or filler, the company stated. Harshaw reports that 6-V-2 is a compatible modified barium-cadmium liquid product and is unsurpassed in retention of properties during storage, compounding, processing and in finished stock.

Hawk Joins Cary Chemicals

► Cary Chemicals, Inc., East Brunswick, N. J., has announced the appointment of David C. Hawk as manager of Technical Service. Mr. Hawk was formerly chief chemist with Ansonia Wire & Cable Co. A graduate of Earlham College, Mr. Hawk has been continuously associated with the electrical wire and cable industry, specializing in plastics. He served as a development engineer with Beldon Mfg. Co. and in a similar capacity with B. F. Goodrich Chemical Co.

Seventh Wire and Cable Symposium Held on December 2, 3 and 4

Wire and Cable Theme of Meeting Technical Progress in Communication

► The Seventh Annual Wire and Cable Symposium, held on December 2, 3 and 4 at the Berkeley-Carteret Hotel in Asbury Park, N. J., had a total registration of 942. Sponsored by the Communications Department of the U. S. Army Signal Research and Development Laboratory, Fort Monmouth, N. J., the theme of the Symposium was "Technical Progress in Communication Wires and Cables."

H. F. X. Kingsley (Signal Corps) served as chairman, while Fred Wills (Signal Corps) acted as co-chairman. The Wire and Cable Symposium Committee was composed of R. Blain (Signal Corps); C. T. Wyman (Bell Telephone Laboratories); M. G. Caine (Monsanto); A. L. McKean (Phelps Dodge); J. L. Robb (Superior Cable); and B. Levinson (Okonite).

The first technical session was held at 9:15 a.m., on Tuesday, December 2, with A. L. McKean (Phelps Dodge) serving as chairman. Col. H. McD. Brown (Signal Corps) delivered the welcoming address. The first paper, entitled "Low Loss Coaxial Cable for High Temperature Service," was presented by W. A. Donohue and F. T. Smith (McGraw Edison). The authors stated that rapid improvements in the performance capabilities of modern aircraft have accentuated the limitations of presently available coaxial cables. There is a need for coaxial cable capable of continuous operation at high temperatures and with improved electrical characteristics.

Conductive Material Suitability

An investigation was undertaken recently on the suitability of various dielectric and conducting materials, coaxial designs and methods of cable fabrication for low-loss, high-temperature coaxial cables. As a result, cables were made which exhibited low loss properties and maximum attenuation stability over a frequency range of 1 to 3000 mc at temperatures to 500° C. These studies also established design criteria for the production of coaxial cables which meet the WADC design objective.

Conducted on refractive oxide systems for use in high temperature coaxial cable, the investigation showed that a properly processed silica can yield a cable which has minimum attenuation rise with temperature and excellent attenuation stability under thermal variation and mechanical stressing. This cable can be fabricated reproducibly and is comparable in its characteristics to the RG-142/U.

"Composite Wires for Operation as Electrical Conductors at Elevated Temperatures," by J. R. Howell (Sylvania Electric), was the next paper. According to Mr. Howell, the aircraft industry now requires conductor temperatures of 750° and up in wiring, and in the future, it will require conductors operating at ambient temperatures of 1000° and up. A new approach to this problem is through composite wires employing either an electroplating process or a "cladding" process, depending on the thickness of coating required and the metal required to provide protection in oxidizing and corrosive atmospheres. In either method, the author stated, high electrical conductivity is provided by the "core" material, while the coated metal provides protection against the various environmental conditions.

It was stressed that several factors have to be considered when specific properties are desired in a high temperature wire. These include conductivity; temperature coefficient of resistivity; oxidation resistance and resistance to other corrosive media; tensile strength at room and elevated temperatures; and thickness of the protective coating. Often, he said, a specific property can be attained only at the sacrifice of one or more other properties. To design a composite, the desirable characteristics must be clearly spelled out and the best possible compromise between all the factors has to be determined. This should be done by calculation and by long and tedious testing. In general, the author concluded, a compromise can usually be made and the optimum conductor developed.

Jerome I. Cohn (Inso Electronic) presented "Development and Application Notes on 'Thin-Wall' Teflon Insulated Wire and Cable." Mr. Cohn said that the advanced nature of today's electrical and electronic equipment introduces the factors of "miniaturization" and "reliability," which increase the complexity of the design factors involved in the specification of wiring. Wire must be designed and chosen not only for the specific task of transferring energy, but for the task of system integration as well. Design and manufacturing considerations require high component quality; high repair accessibility; high safety factors; and high performance with great reduction in the size and weight of equipment.

After more than three years of research and development, a Teflon wire process has been developed that offers considerable advantages over the conventional processes of extrusion and tape wrapping that are now in existence. This process is essentially a new method of precision wrapping and complete fusing of Teflon tape. During this fusing process, the Teflon tape loses its identity as a tape and becomes a homogeneous mass with an outstanding dielectric quality, Mr. Cohn said.

Mr. Cohn continued to say that the concept of wire as a "system" or as a "system sub-assembly" introduces many new problems such as saving of space and weight; long length-pin-hole free; concentricity of insulation; oxidation of silver plated conductor; breakage of wire at soldered joints such as shock resistance, wicking action and stripping insulation; and marking of Teflon wire. He believes that consideration of these problems using "Fused Film" wire as the prime basis of analysis highlights some of the more important critical design criteria.

The first technical session was closed with a paper entitled "Evaluation of Multiconductor Cables Used in Ground to Air Missile Systems," by T. J. Horan and J. J. Roache. Presided over by J. L. Robb (Superior Cable), the second technical session was held at 2 p.m. on Tuesday, December 2. The session was opened with a paper by Dr. C. A. Neros (Diamond Alkali) and R. C. Graham (Rome Cable). It was explained that when polyethylene was introduced, the material was found to be the best electrical insulator yet developed for wire and cable. However, it was highly flammable.

Flame Retardant Polyethylene

The authors described research undertaken to develop flame retardent polyethylene formulations that would maintain a maximum of original polyethylene characteristics, especially those properties having significance for insulation or jacket on wire and cable. They said that loadings on polyethylene up to 36 per cent with proper ratios of chlorinated paraffin to antimony trioxide produced wire coating compounds meeting the desired levels of flame retardancy. The use of high molecular weight polyethylene improved physical characteristics of the resultant mixture. The addition of small quan-

tities of butyl rubber to the extent of about 5.0 per cent on the polyethylene further improved properties so that the final compound more closely exhibited the original performance characteristics of the polyethylene resin. These compositions have been found to produce satisfactory insulation and jacket compounds, the authors stated.

In "Even Count Polyethylene Insulated Cable," by F. W. Horn (Bell Telephone Laboratories), Mr. Horn explained that even count cable is designed around the concept of 25 pair color groups which in the larger cable adds up to 100 pair multiples. In this system, cables of various sizes may be spliced together without losing the identity or count of any pair and a simple record keeping and assignment system is made possible. The paper followed the evolution of even count cable, the conditions that paved the way for its introduction, the development problems involved and the advantages of the even count system. After the achievement of good mechanical and electrical results on experimental cables, formal designs for a complete series of even count polyethylene insulated cables in 19, 22, 24 and 26 gauges were drawn up. It was stated that all polyethylene insulated cable turned out for the past several months have been of the new even count series.

Other papers delivered during the second technical session were "An Air-Layable Carrier Frequency Cable for Mobile Warfare," by W. C. Murray (ITT Laboratories) and F. W. Wills (Signal Corps); "Alumoweld, a New Bimetallic Wire for Electrical and Strength Applications," by F. E. Leib (Copperweld Steel); and "Crosstalk and Capacitance Unbalance Measurements, Procedures, and Significance in Multi-Conductor Cables," by J. A. Pettit, Jr. (Engineered Wire).

Plasticizers and PVC Resins

Chairman C. T. Wyman (Bell Telephone Laboratories) presided over the next technical session, which was held at 9:30 a.m., on Wednesday, December 3. The session was opened with a discussion of "Effects of Plasticizers Upon Dry Blending Polyvinyl Chloride Resins," by Russell A. Park (Firestone Plastics). Mr. Park explained that the term "dry blending" resin has different meanings to the various resin users in the polyvinyl chloride field. In some instances, "dry blend" refers to the visual appearance of a resin-plasticizer-filler, etc., mixture to which heat has been added. After the addition of heat, the resin appears "dry" or has flowability. The term "dry blend" also refers to very highly plasticized resin-filler mixtures which, while they do not retain flowability, remain sufficiently fluffy to be dumped in mass. This type of mixture, in most cases, is blended without the aid of heat. The author described the application requirements of these two types of resin, dealing with the effects of plasticizers in the concentrations most often encountered in the calendering, dry blend extrusion and injection molding fields.

"Influence of Water Immersion on Electrical Characteristics of Silicone Rubber" was presented by M. G. Noble (General Electric), and W. L. Seamonds (Simplex Wire). This paper discussed the moisture resistance of silicone rubber, pointing out how the electrical engineer in the wire and cable industry can make good use of the moisture resistance of silicones. The authors described the variables that influence the performance of this material in wet locations and those limitations that are revealed by long term immersion of silicone rubber in water. Such variables as filler, voltage, insulation wall, and temperature, exert significant influence on the electrical properties of silicone rubber-insulated wire when subjected to prolonged water-immersion tests. Compounds have passed accelerated testing in water up to 70°C. However, power cable insulation of this rubber, as presently compounded, cannot be recommended as resistant to accelerated testing in 90°C water for more than short periods of time, it was claimed.

W. F. Fischer and W. C. Smith (Enjay) presented a paper entitled "Enjay Butyl in Low Voltage Applications." According to the authors, two

Rubber Industry Pays Tribute To Litchfield

P. W. Litchfield and Portrait

► More than 800 industrial, civic, and local and state government leaders met at a testimonial dinner held on December 15 at the Sheraton Hotel in Akron, Ohio, in honor of Paul Weeks Litchfield, retired chairman of the Goodyear Tire and Rubber Co. The dinner was highlighted by an announcement that the Goodyear board of directors had voted to commission one of the nation's leading sculptors to do a life-size bronze of Mr. Litchfield, which, in time, will be placed in the company's world wide headquarters at Akron.

Cited as the guiding genius of many important developments in the rubber industry, Mr. Litchfield was also presented with two large leather volumes containing letters of congratulation upon the occasion. Letters came from such persons as President Eisenhower, Vice-President Nixon, Secretary of State Dulles and other cabinet members as well as other governmental and industrial leaders from all over the world. A motion picture depicting the life of Mr. Litchfield was another feature of the evening.

Introduced by John S. Knight, publisher of Knight Newspapers many industry leaders paid tribute to the retired Goodyear executive including Harvey S. Firestone, Jr., board chairman of the Firestone Tire and Rubber Co.; William O'Neil, president and chairman of the General Tire and Rubber Co.; Arthur Kelly, executive vice-president of B. F. Goodrich Co.; H. E. Humphries, Jr., chairman of the U. S. Rubber Co.; and J. P. Seiberling, president and chairman of the Seiberling Rubber Co. Seated at the speakers' table, but not addressing the audience were Ross R. Manufacturers Association, Inc.; Angus Macdonald, president of the Akron Chamber of Commerce; and E. D. Viers, who, along with Mr. Litchfield, is the last of the Goodyear "Old Guard" as the early nucleus of employees has been known.

Associated with Goodyear for 58 of the company's 60 years, Mr. Litchfield was cited as being personally responsible for numerous innovations contributing to the growth and progress of the industry. When he joined Goodyear in 1900, the company employed 176 men. When Mr. Litchfield retired as honorary chairman in October 1958, the company, under his leadership, had grown into a world wide organization of 100,000 employees.

promising butyl compounds, one black and one light colored, have been developed to meet service requirements for insulation in power and communication wire designed for service under 600 volts. The black compound meets initial physical and electrical requirements for low voltage block (telephone ringing circuit), and power wire insulation and has proved to have good long term weatherability.

The light compound was developed more recently as color-coded insulation for multiconductor drop (pole to house) wire. This latter material may be of greater long range importance since it is tougher, snappier and has better electrical and compression properties. The authors stated that laboratory tests had shown that both of these new materials have better electrical properties, superior heat stability and much lower water absorption than the competitive elastomer jacket compounds currently in use.

The last paper in this session was entitled "Rodent Attack on Rubber and Plastics Insulated Wires and Cables," by Dr. G. R. Bjorck, B. F. Lizell and J. S. Roos (Sieverts Kabelverk, Sweden). An investigation showed that rats attack materials which have no function as food and none of the materials that had been tested were completely rat-proof. The authors said that hard or rigid materials resist attack better than soft ones. Soft rubber or plastic materials are not likely to resist attack, while rigid types in thick sections will probably be damaged only to a small extent. They felt that the development of rodent-resisting rubber and plastic materials is rapidly becoming more urgent.

Carbon Black Dispersion

The next technical session, on Wednesday, December 3, was chaired by M. G. Caine (Monsanto). G. G. Cocks and A. P. Metzger (Batelle Memorial Institute) presented a paper on "Measurement of the Degree of Dispersion of Carbon Black in Polyethylene Using Absorption of Light." According to the authors, the rate of deterioration of polyethylene exposed to light and atmospheric gases can be reduced by addition of carbon black. However, at present, there is no entirely satisfactory method of measuring the degree of dispersion of carbon black in polyethylene and it is difficult, if not impossible, to establish satisfactory specifications for degree of dispersion.

In the experiments reported, sources of variability in the present method of measuring dispersion using light absorptivity techniques were examined. The authors said that if the causes of variability could be determined, it should be possible to modify the present specification or to suggest a new and more accurate method of specifying the dispersion of carbon black in polyethylene.

Absorptivity measurements on a number of carbon black-pigmented samples, using a method prescribed by Federal Specification L-P-590 and the microspectrophotometer technique developed in this work, indicated that the proposed specification will not provide the degree of product control that was intended. It was suggested that a revised standard method for determining absorptivity be developed.

"Microdensitometric Determination of Dispersion," which followed, was presented by W. G. Best and H. F. Tomfohrde, III (Bakelite). The paper described the development of a reasonably precise microdensitometer and also the mathematical treatment of resulting data, which are said to have enabled the study of carbon black dispersion. The method and apparatus for the measurement of carbon black dispersion in polyethylene were briefly described. The authors illustrated a potential method, which they claimed, is free of empirical influences; more reliable and precise, and less time consuming. Testing to date indicates that, with more precise instrumentation, it should be possible to measure carbon black dispersion and gels independently and to determine, electronically, a dispersion index.

P. L. Clegg, S. Turner and P. I. Vincent (Imperial Chemical) discussed "Polythene-Mechanism of Fracture." The authors felt that there is a need for a comprehensive account of the ways in which mechanical failure occurs in polythene. They discussed studies of polythene in terms of tensile failure; impact failure; low temperature failure; film failure; and long time failure. The last category was broken down into three subdivisions including environmental stress cracking, stress failure, and high temperature failure. The authors expressed the hope that the paper would stimulate interest in the problem of relating test results to service behavior. The problem, they said, is further complicated by the effect of different fabrication conditions. It was felt that a solution could be achieved only by a more thorough understanding of the fundamental mechanisms involved in fracture.

"Thermal Stress Cracking of Polyethylene-II" was presented by J. H. Heiss, V. L. Lanza and W. M. Martin (Bell Telephone Laboratories). An earlier report, "The Thermal Embrittlement of Stressed Polyethylene," was cited by the authors. In this report it had been shown that high density polyethylenes cracked open when heated in a strained condition at temperatures ranging from 23°C. to 120°C. Further investigation into other levels and types of strain was the basis for this report. The authors said that under comparatively low strains, high density polyethylene thermally stress-cracked in essentially uniaxial tension in the same manner as in the helical-wrap test. This was not at variance with the earlier proposed hypothesis involving elastic distortion of spherulites. In both tests the limiting value of strain, as well as the time to failure at various strain levels was about the same.

Observations have shown that thermal stress-cracking and heat embrittlements, which is presumably due to gross changes in crystalline texture, are different phenomena. Further testing has substantiated the fact that high density polyethylenes are quite susceptible to thermal stress-cracking, while low density polyethylenes do not appear to be affected. It also appears, the authors said, that thermal stress-cracking can occur in molded parts containing "frozen in" strains.

Cross-Linkd Polyethylene

"Carbon-Black-Loaded Cross-Linked Polyethylene in Wire and Cable" was presented by B. B. S. T. Boonstra (Cabot) and Allen C. Bluestein (Anaconda Wire). According to the authors polyethylene had proved to be useful in the electrical wire and cable field, but the material offered several disadvantages. The disadvantages are poor ultraviolet light resistance; plastic flow at elevated temperatures; high shrinkage due to high degree of crystallinity at room temperature; stress cracking in detergents or at temperature changes.

The authors stated that the first drawback had been virtually overcome, and suggested chemical cross-linking be used as a method to improve the other

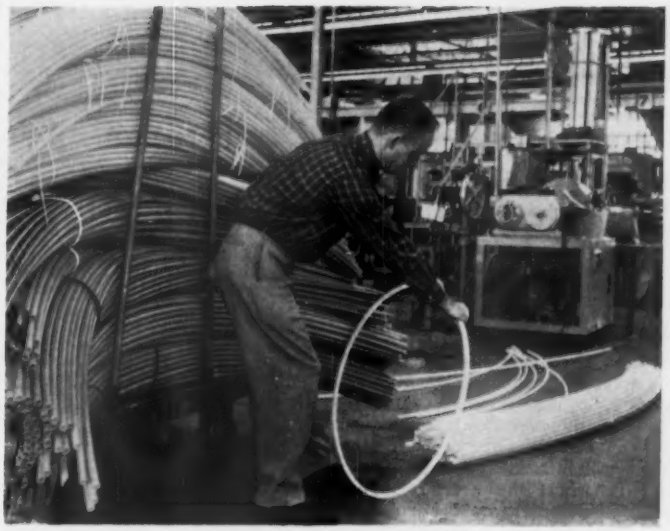
Help Wanted

► Naval Air Material Center, Philadelphia, Penna., has an urgent need for qualified electronic scientists, metallurgists, physicists, technologists and engineers (aeronautical, electrical, electronic, industrial, general, mechanical and power plant). The center is currently engaged in an extensive program of aeronautical research, development experimentation and test operations for the advancement of naval aviation and experimental work in the guided missile field. Starting salaries range from $4490 to $8330 per annum. Application for Federal Employment, Standard Form 57, should be filed with the Industrial Relations Department, Naval Air Material Center, Naval Base, Philadelphia 12, Penna. Application may be obtained from the above address or information as to where they are available may be obtained from any first or second class post office.

disadvantages of the material. It was noted that although the carbon black loaded, chemically cross-linked polyethylene compounds are not the best in every test comparison made, they show a remarkable combination of desirable properties of interest to the wire and cable industry.

The following paper was entitled "Chemically Cross-Linked Polyethylene" and was presented by E. R. Kerwin (General Electric). Mr. Kerwin said that considerable research has been conducted with polyethylene and variations in physical and electrical properties have been accomplished. Several polyethylene based compounds, such as Irrathene, Hypalon and Vulkene were discussed. The author said that present Vulkene compounds do not equal the electrical properties of conventional polyethylene, but they are comparable, and the over-all properties are superior to many thermoplastic and thermosetting insulations used in a wide variety of applications.

Mr. Kerwin believes that significant advantages can be realized with Vulkene in installations involving overloads and short circuits; high ambients; exposure to solvents and chemical reagents; abrasion and high impact problems; and low temperatures operations. He stated that the verified heat stability and mechanical properties provided with Vulkene compounds, even at the present stage of development, warrants consideration by the wire and cable designer and user in all installations where immediate advantage can be taken of these characteristics.



Hula Hoops Keep Rolling

► A technician at the extrusion plant of the Borden Chemical Co., North Andover, Mass., checks some of the thousands of feet of linear polyethylene lengths turned out by the plant to help meet the continuing demand for hula hoops. The company will continue to produce the extruded material as long as the demand exists and will also continue its regular production of garden hoses and sprinklers.

Last Technical Session

The last technical session was held on Thursday, December 4, with B. Levinson (Okonite) presiding. The first paper, entitled "New Extrusion Techniques with Silicone Rubber," was presented by H. H. Bashore, E. G. Schwarz, and C. E. Simpson (Union Carbide). The authors said that the electrical industry consumes a larger volume of silicone rubber than any other single user. The emphasis during the past few years has been on improving the properties of the silicone compounds while little effort has been made to improve the handling characteristics of the materials. Handling problems had been solved, they said, through the development of direct-feed silicone rubber compounds. The concept of the direct feed silicone rubber compounds was explained. They stated that the latest developments in silicone rubber had been those of improved processability and fabrications techniques. This technology has been extended to other wire and cable specifications, it was claimed.

D. A. Trageser (High Voltage Engineering) delivered a paper on "Electron Processing Techniques for Wire and Cable Irradiation." In this paper, he stated that the radiation cross-linking of elastomers and of polyethylene has been studied intensively in the last few years and there are already some commercial processes based on the irradiation of polyethylene-coated wire and also of tape for the wrapping of coils and cable. Many types of radiation sources have been used experimentally to explore the change of physical properties in polymers. The high-energy beams from electron accelerators have enough compacted radiation, power, and efficiency of application to be of economic interest for present and future applications in the wire and cable industry.

"The Effects of Radiation of Silicone Rubber Wire and Cable Insulation" was presented by C. G. Currin (Dow Corning). Mr. Currin stated that all nuclear power plants require various control and energy transfer components, including wire and cable. For the practical operation of the plant many of these components must be exposed to nuclear radiation. Studies of rubber exposed to radiation, indicated that: (1) Dielectric properties of silicone rubber insulation are not permanently affected to a significant degree by gamma irradiation; (2) Dielectric losses during irradiation are no higher than before or after the exposure; (3) Physical properties of silicone rubber wire and cable are damaged by irradiation; (4) Irradiation at 200°C. has the same general effect as irradiation at 25°C. except that the rate of damage is accelerated four to ten times; (5) Differences in radiation resistance between silicone rubber stocks is greater when irradiated at 200°C. than at 25°C.; (6) The effects of radiation of physical properties limits the life of the material. For many nuclear applications, this life may be a number of years, depending on the radiation intensity involved; (7) For those applications where a life greater than five megarads is necessary, all of the generalized information necessary to predict performance is not yet available.

The last paper, presented by R. I. Leininger and C. J. Lyons (Batelle Memorial Institute), was entitled "Nuclear Radiation—A New Environment for the Wire and Cable Engineer." The authors discussed the effects of radiation on materials of interest to the wire and cable industry.

► A special report, entitled "The Galveston Story", has been published by the Chemical Division of Goodyear Tire & Rubber Co., Akron, Ohio, that tells how the deteriorating effect of high humidity, salt air, hot sun and industrial fumes on painted masonry surfaces was overcome with paints made from "Pliolite S-5."

Tentative Program Scheduled For International Rubber Conference

Interesting Papers Planned for November Meeting in Washington

► A tentative program has been scheduled for the International Rubber Conference, to be held from November 8 to 13 in Washington, D. C. Titles for papers on various aspects of rubber technology have been submitted by scientists throughout the world and abstracts of these papers are due on January 1, 1959. The final program will be arranged by the full Program Committee on the basis of the abstracts.

Members of the Program Committee are R. G. Seaman, J. D. D'Ianni, C. F. Gibbs, W. F. Tuley, G. C. Maassen, O. D. Cole, R. D. Stiehler, G. Bruggemeier, M. E. Lerner, A. E. Juve, J. J. Allen, H. G. Bimmerman, S. Collier, A. W. Sloan, E. H. Krisman, R. H. Gerke and R. F. Dunbrook.

As presently set up, the program for the conference will consist of eleven technical sessions, with several papers to be presented at each. A listing of the technical sessions and papers scheduled to date follows:

I. Equipment and Processes in Rubber Manufacturing

1. *The Rotomill—A Continuous Mixing Device,* by A. E. Juve, J. R. Beatty, A. G. Veith and R. H. Kline (B. F. Goodrich Research Center) (ACS-USA).

2. *What Bladderless Curing of Tubeless Tires Can Mean in Increased Productivity,* by George N. Murphy (National Rubber Machinery) (ASME-USA).

3. *Latest Developments in Screw Type Continuous Mixers,* by Robert H. Kline (National Rubber Machinery) (ASME-USA).

4. *Global Developments in Tire Production,* by C. A. Litzler (C. A. Litzler) (ASME-USA).

5. *Latex Masterbatching: Compounding, Developments, Future Possibilities and Influence on Rubber Manufacture,* by I. Drogin (United Carbon) (ACS-USA).

II. Elastomers as Engineering Materials

6. *Elastomers in Naval Machinery,* by E. M. Herman, J. S. Post, S. O. Patton (U. S. Naval Engineering Experiment Station) (ASME-USA).

7. *Urethane Polymers as Engineering Materials,* by J. G. Di Pinto (DuPont) (ACS-USA).

8. *Effect of Composition on Flow Properties of Polymeric Sealants,* by J. Gaynor, G. W. Blum, E. G. Bobalek, and C. P. Alexander (Case Institute) (ACS-USA).

III. Advances in Test Methods

9. *Micro-Hardness Testing of Rubber, its Possibilities and Limitations,* by J. R. Scott, A. L. Soden (Research Association of British Rubber Manufacturers) (England).

10. *Micro-Hardness and Micro-Rebound Measurements,* by S. Oberto (Pirelli Rubber Laboratories) (Italy).

11. *New Artificial Weathering Methods,* by G. F. Bush (G. F. Bush Associates) (ASTM-USA).

12. *The Natural and Accelerated Ozone Aging of Elastomer Compounds,* by M. M. Lowman (Goodyear) and H. P. Miller (Goodrich) (ASTM-USA).

13. *Measurement of the Coefficient of Dynamic Friction of Rubber on Wet Surfaces,* by P. Thirion and R. Chasset (Institut Francais du Caoutchouc) (France).

14. *Viscosity and Relaxation Measurements on Crude Rubbers and Compounds,* by S. Eccher (Pirelli Rubber Laboratories) (Italy).

15. *Sulfur Group Analyses in Natural Rubber Vulcanizates,* by M. L. Studebaker and L. G. Nabore (Phillips Chemical) (ACS-USA).

16. *Aging of Rubber Vulcanizates,* by J. Mandell, F. L. Roth, M. N. Steel and R. D. Stiehler (National Bureau of Standards) (ACS and ASTM-USA).

IV. Products and Product Testing

17. *A Towing Device for Estimating Road Wear,* by L. P. Gelinas and E. B. Storey (Polymer Corp.) (ACS-Canada).

18. *An Indoor Tester for Measuring Tire Treadwear,* by G. G. Richey, J. Mandell, M. N. Steel and R. D. Stiehler (National Bureau of Standards) (ASTM and ACS-USA).

19. *Measurement of Tread Motion and Application to Tire Performance,* by H. H. Vickers and S. B. Robison (Esso Research and Engineering) (ACS-USA).

20. *International Road Testing of HAF and ISAF Blacks in Passenger Tires,* by O. F. K. Bursemaker (NV Rubber Fabrick), E. M. Dannenberg (Cabot), and H. Westlinning (DeGussa) (ACS-Netherlands, U. S., Germany).

21. *Aircraft Tire Testing Developments,* by Harold P. Lamp (Adamson United) (ASME-USA).

22. *The Role of Hysteresis in Tyre Wear,* by A. Schallamach (British Rubber Producers Research Association) (England).

23. *Power Wastage in Tires,* by G. B. Roberts (Dunlop Rubber) (England).

24. *Power Loss in Tires,* by R. D. Stiehler, M. N. Steel, G. G. Rickey, J. Mandell and R. H. Hobbs (National Bureau of Standards) (ASTM and ACS-USA).

25. *The Mechanical Behaviour of the Tire in Dependence on Materials and Construction,* by W. Hofferberth (Deutsche Dunlop) (Germany).

26. *Retreading of Tires,* by H. Geldorf (Rubberinstituut T. N. O. Delft) (Netherlands).

V. Statistical Methods in the Rubber Industry

27. *Quality Control for the Rubber Industry,* by Simon Collier (Johns-Manville) (ASTM-USA).

VI. Nomenclature and Classification

28. *A Practical Method of Classifying All Elastomeric Vulcanizates,* by N. L. Catton, R. C. Edwards and T. M. Loring (DuPont) (ASTM-USA).

VII. New Developments in Elastomer Reinforcement

29. *Effect of Type of Zinc Oxide on Properties of Various Elastomers,* by H. P. Schwarz (Sherwin-Williams) (ACS-USA).

30. *Filler Action in Reinforcement,* by L. Mullins (British Rubber Producers Research Association) (England).

31. *Elastomer-Filler Interaction,* by J. P. Berry, P. J. Cayre and M. Morton (University of Akron) (ACS-USA).

32. *Interaction of Hydrocarbons and Powders,* by W. A. Wake (Research Association of the British Rubber Manufacturers) (England).

33. *Theoretical Study of Elastomer Reinforcement as a Function of Particle Size,* by A. J. Mueller (G. F. Bush Associates) (ASTM-USA).

34. *Nitrogen as a Filler,* by E. V. Osberg, H. A. Hill and H. R. Lasman (National Polychemicals) (ACS-USA).

35. *Swell Resistance of Polymer-Filler Systems to Boiling Water,* by S. Palinchak and W. J. Mueller (Battelle Memorial Institute) (ACS-USA).

VIII. Compounding Developments: (a) Vulcanization

36. *Estimation of the State of Cure of Elastomers by Means of Radioactive Sulfur,* by H. Leth Pedersen (Nordiske Kabel-OG Traadfabriker) (Denmark).

37. *Properties of Compounds Relative to Vulcanization,* by J. H. Gifford (Witco Chemical) (ACS-USA).

38. *Chemical Interpretation of Di-Cup Vulcanization,* by W. D. Willis and

L. O. Amberg (Hercules Powder) (ACS-USA).

39. *Chemistry of the Curing of "Viton" Fluorocarbon Elastomer,* by J. F. Smith (DuPont) (ACS-USA).

40. *Crystallization and Cure Studies of Neoprene W Using Dielectric Measurements,* by M. Hanok (New York Naval Shipyard) (ACS-USA).

41. *Investigation of Radical and Polar Mechanisms in Vulcanization Reactions,* by J. Reid Shelton and E. T. McDonel (Case Institute) (ACS-USA).

(b) Rubber Chemicals

42. *The Consumption of Antioxidants During Aging,* by H. Geldorf (Rubberinstituut T. N. O. Delft) (Netherlands).

43. *A Study of the Behaviour of Selected Substituted Diphenyl Amines in Rubber Compounds,* by J. T. Watts (Imperial Chemical Industries) (England).

(c) General Compounding

44. *Standards for Rubber Compounding,* by F. L. Roth and R. D. Stiehler (National Bureau of Standards) (ASTM-USA).

45. *The Use of Regression Techniques in Elastomer Compounding,* by C. F. Bertsch (DuPont) (ACS-USA).

(d) Adhesion

46. *Mechanism of Adhesion in Polymeric Systems,* by S. B. Robison and D. J. Buckley (Esso Research and Engineering) (ACS-USA).

47. *Aspects of Rubber/Textile Adhesion,* by G. M. Doyle (Dunlop Rubber) (England).

IX. Polymers and Polymer Structure: (a) General

48. *Cis-Trans Isomerization of Polyisoprene and Related Compounds,* by J. I. Cunneen (British Rubber Producers Research Association) (England).

49. *New Chemical Derivatives of Rubber Having High Elasticity,* by C. Pinazzi, and G. Milbert (Institut Francais du Caoutchouc) (France).

50. *Polymerization of Vinyl Monomers in Natural and Synthetic Latices,* by E. G. Cockbain (British Rubber Producers Research Association) (England).

51. *Properties of Tin Elastomers,* by J. C. Montermoso, T. M. Andrews, L. P. Marinelli and B. La Liberte (Quartermaster Research and Development Center) (ACS-USA).

52. *Silicone Rubber—Today and Tomorrow,* by P. C. Servais and K. Polmanteer (Dow Corning) (ACS-USA).

53. *The Structure of Chlorosulfonated Polyethylene,* by A. Mersasian and D. E. Anderson (DuPont) (ACS-USA).

(b) Polyurethanes

54. *Relation of Structure to Properties in Polyurethanes,* by E. F. Chuff and J. B. Rogan (DuPont) (ACS-USA).

55. *Structure of Diisocyanate as the Variable in Polyurethane Elastomers,* by G. C. Toone (National Aniline) (ACS-USA).

56. *TDI Index and its Effect on Flexible Polyurethane Foam Properties,* by M. E. Bailey (National Aniline) (ACS-USA).

57. *Polyurethane Foam for Transportation Seating,* by G. B. Middlebrook (National Aniline) (ACS-USA).

58. *Process Problems in the Production of Polyether Foam Prepolymers,* by C. E. McGinn (National Aniline) (ACS-USA).

X. Natural Rubber and Latex

59. *Preservation of Natural Rubber Latex in the Field,* by J. S. Lowe (Dunlop Research Center-Malaya) (ACS-Malaya).

60. *Modern Large Scale Production of Hevea Rubber and Hevea Latex Concentrate,* by G. Verhaar (Firestone Plantations) (ACS-Liberia).

61. *Some Aspects of the Exploitation of Hevea Brasiliensis,* by C. W. Brookson, P. de Jonge, P. R. Wycherley and J. M. Ross (Rubber Research Institute of Malaya).

62. *Progress in Improving the Production of Heveas,* by J. Le Bras (Institut Francais du Caoutchouc) (France).

63. *Developments in Superior Processing Natural Rubber,* by H. C. Baker (British Rubber Producers Research Association) (England).

64. *Increasing Yields of Latex by Biological and Chemical Means,* by E. D. C. Baptiste (Ceylon Rubber Institute).

65. *A Zinc Stability Test for Hevea Latex,* by J. L. M. Newnham and D. J. Simcox (Dunlop-England) (England).

66. *A Strain Test for Latex Films and its Application,* by P. R. Gyss and Charles E. Woo (Socfin) (ACS-Malaya).

67. *Factors Influencing the Stability of SBR Latex,* by F. A. Shiemers, B. Bennett, F. B. Stickney and R. G. Heiligmann (Battelle Memorial Institute) (ACS-USA).

68. *The Colloidal Properties of Synthetic Copolymer Latices,* by C. F. Fryling (Koppers) (ACS-USA).

XI. Theory

69. *Measurement and Interpretation of the Rate of Volume Swell and Equilibrium Volume Swell in Cross-Linked Elastomers,* by D. J. Buckley and M. Berger (Esso Research and Engineering) (ACS-USA).

70. *Fatigue Characteristics of Elastomeric Compounds with Biaxial Stretching,* by C. S. Wilkinson, Jr. and S. D. Gehman (Goodyear) (ACS-USA).

71. *Behaviour of Vulcanized Elastomers in Biaxial Tearing,* by R. Chasset and P. Thirion (Institut Francais du Caoutchouc) (France).

72. *Strain Energy of Various Vulcanizates,* by M. Mooney (U. S. Rubber Research Center) (ACS-USA).

73. *Response of Elastomers to Any Forcing Function,* by M. Berger (Esso Research and Engineering) (ACS-USA).

74. *A Theory of the Abrasion of Rubber,* by F. W. Boggs (U. S. Rubber) (ACS-USA).

75. *Some Statistical Considerations Underlying Molecular Theories of Rubber Elasticity,* by Turner Alfrey, Jr. and Jacob Mazur (Dow Chemical) (ACS-USA).

76. *New Fundamental Relation Between Viscosity and Structure of Large Organic Molecules in Solution,* by A. R. Kemp (Tlargi Foundation, University of Southern California) (ACS-USA).

Thiokol Stock Is Listed

► Thiokol Chemical Corp., Bristol, Penna., producer of synthetic rubber and manufacturer of solid and liquid rocket propulsion systems, has been listed on the New York Stock Exchange. The company will be known on the trading floor by the symbol "THI". With its listing on the Exchange, Thiokol joins some 1100 corporations whose number of listed shares total 4.8 billion and are valued at about $200 billion.

Chicago Group Party

► The Chicago Rubber Group held its annual Christmas Party on December 19, 1958 at the Morrison Hotel. Members and their wives danced to the music of Lou Breese. Ladies favors were pieces of luggage to form matching sets with overnight cases and luggage given in previous years. A five act show presented by Marvin Himmel Productions provided the evening's entertainment.

General Cable Acquires Cornish

► General Cable Corp., New York, N. Y., has acquired the Cornish Wire Co., Inc., New York, N. Y., through an exchange of 50,000 common shares of General Cable for all of the 186 shares of Cornish issued and outstanding. The closing was to have been on January 2. This was disclosed in an application by General Cable for listing the 50,000 shares on the New York Stock Exchange. Based on a final price of $41 a share on the New York Stock Exchange on December 29, value of the Cable stock involved is $2,050,000.

Shell Chemical Integrates

► Shell Chemical Corp., New York, N. Y., has announced that its Synthetic Rubber Sales Division will be combined with corresponding company Production and Research Departments to form an integrated Synthetic Rubber Division. According to the company, the primary purpose of the integration is to improve customer service.

Fort Wayne Hears Beekley On PVC Rubber Compounds

► The second meeting of the 1958-59 season of the Fort Wayne Rubber and Plastics Group, held on December 4, 1958, at the Van Orman Hotel, Fort Wayne, Ind., was attended by 198 persons and featured an address by N. S. Beekley. Mr. Beekley, of Goodyear Tire & Rubber Co., gave an interesting and illustrative talk on "Thermoplastic Acrylonitrile Rubber PVC Compounds." He explained the role played by PVC compounds in rubber manufacturing. He began the discussion by saying that World War II shortage of rubber gave impetus to the development of polyvinyl chloride resins and their many applications. This development was aided when the usual rubber processing equipment, with some modification, could be used to produce PVC compounds. He went on to discuss the physical characteristics of PVC and the problems akin to its processing.

He said that the satisfactory compounding of nitrile rubber in PVC had previously required long breakdown periods on open mills before combing with the polyvinyl chloride, and what steps were taken to simplify the procedure.

He also discussed the work being done on thermoplastic compounding in Goodyear laboratories in order to obtain from the compounds such characteristics as excellent low temperature properties, resistance to extraction by petroleum products, unlimited color, excellent outdoor weathering, flame resistance and have good processing characteristics. Mr. Beekley summed up his talk by stating that he believed the combination of PVC resins and acrylonitrile-butadiene rubber are worthy of consideration for application as thermoplastic blends for specific end uses. The limitations of these materials are recognized for both processing and product, however the combination of nitrile rubber and polyvinyl chloride may be the solution of some of the more difficult compounding problems.

Group Officers Installed

► The Northern California Rubber Group installed its officers for 1959 at the annual Christmas party on December 6, 1958, at the Orinda Country Club, Orinda, California. Elected to office were: *Chairman*, Drace Kutnewsky (Burke Rubber); *Vice-Chairman*, C. C. Corkadel (Oliver Tire & Rubber); *Secretary*, Raymond Brown (Burke Rubber); *Treasurer*, Joseph L. Mattson (Witco Chemical); *Directors*, Keith Large (Oliver Tire & Rubber); Vic Carrier (Oliver Tire & Rubber); and Virgil Price (Burke Rubber). The Christmas party was attended by 140 persons and featured dinner, dancing, orchids, favors and door prizes.

Edward C. Brown, Jr.

Nathan A. Beekley, Jr.

Goodyear Names Two Representatives

► Goodyear Tire & Rubber Co., Akron, Ohio, has announced the appointment of Nathan A. Beekley, Jr., as special representative for the Chemical Division's New York district, and the transfer of Edward C. Brown, Jr., special representative, from the New York office to the division's Philadelphia office. Mr. Beekley, former senior chemical engineer in the Development Department of Goodyear, will be concerned with the sale of Plioflex and Chemigum synthetic rubbers and Pliovic vinyl resins in lower New York State, northeastern Pennsylvania and northern New Jersey. Mr. Beekley graduated from Tri-State College with a degree in chemical engineering and joined Goodyear in 1955. He holds a number of patents and is a member of the American Chemical Society, the Society of Plastics Engineers and the Akron Rubber Group.

Mr. Brown's new territory will be southeastern Pennsylvania, southern New Jersey, Delaware, Maryland and Virginia. He joined the company in 1954 and after three years of technical service in the Plastics Department, was assigned to New York as special representative. He graduated from Montana State College with a B.S. degree in electrical engineering and is a member of the American Chemical Society, Society of Plastics Engineers and the New York Rubber Group.

General Aniline Names Shelton

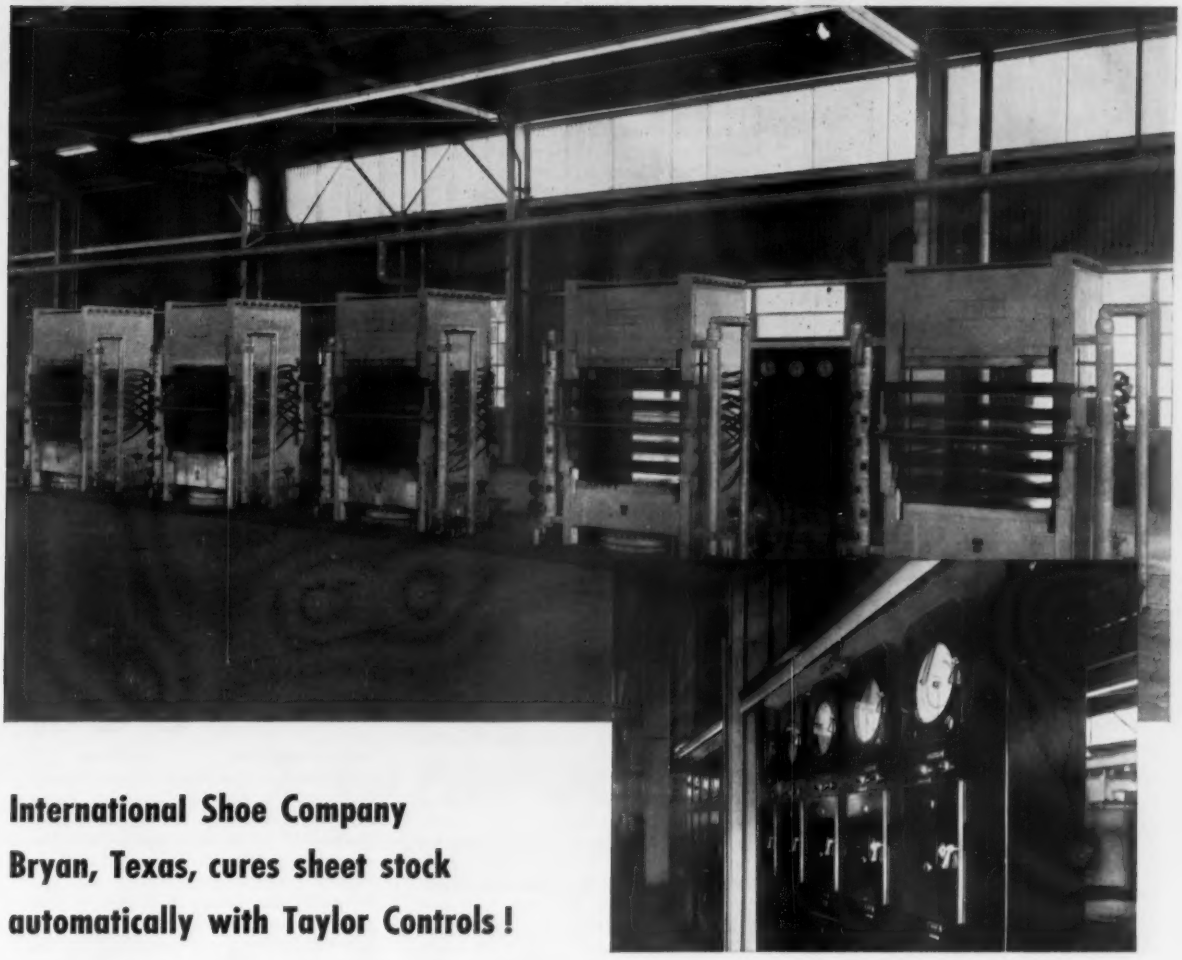
► Harold G. Shelton, formerly manager of marketing, has been named general manager of the Dyestuff & Chemical Division of General Aniline & Film Corp., New York, N. Y. Mr. Shelton joined General Aniline in 1945 as sales manager of the Antara Chemicals Sales Department of the Dyestuff & Chemical Division. In 1957, he was appointed marketing director of the division with the responsibility of all sales activities. Prior to joining General Aniline he was associated with Union Carbide. He is a graduate of Virginia Polytechnic Institute, receiving his B.S. degree in engineering in 1931. Mr. Shelton is a member of the Manufacturing Chemists Association, Armed Forces Chemical Association, American Ordnance Association, American Association of Textile Chemists and Colorists, Dry Color Manufacturers Association, Association of American Soap & Glycerine Producers, Inc., and the Synthetic Organic Chemical Manufacturers Association.

Thermoid Merger Completed

► Thermoid Co., Trenton, N. J., has become an important part of the new Thermoid Division of H. K. Porter Co. (Delaware) as the result of action taken by the boards of Thermoid and H. K. Porter, Inc., and favorable response from more than 80 per cent of Thermoid's stockholders. The Thermoid Division will manufacture and market all products previously made by the Thermoid Co. and Porter's Quaker Rubber Division, including such brands as "Thermoid", "Quaker", "Quaker Pioneer", "Amco", "V-T", "Southern Asbestos" and "Aeroduct" rubber and friction products for automotive, aircraft and industrial use.

The new division is headed by Warren E. Hill, formerly Thermoid president, who will serve as vice-president and general manager. George Dauphinais will serve as vice-president, operations; J. R. Alexander as vice-president, marketing; and E. G. Counselman as general sales manager of the division.

SOLE CONTROL



International Shoe Company Bryan, Texas, cures sheet stock automatically with Taylor Controls!

TAYLOR controls on their platen presses provide many benefits for the International Shoe Company.

1. **They protect International's fine name by insuring a uniformly high quality in their sheet stock.**
2. **Press performance is 100% predictable.**
3. **Since the entire sequence and duration of the cure is automatically controlled, production schedules can be set up so that the minimum number of operators can be used for the maximum number of presses. Skilled operators are thus released for other duties.**

The larger photograph above illustrates the battery of French Oil Mill Machinery Co. 42″ x 42″ platen presses, with one of the Taylor instrument panels in the background. Inset picture gives a close-up view of the control panel for ten 30″ x 30″ presses. The FULSCOPE* Controllers at top regulate platen temperature, while the FLEX-O-TIMER* Time Cycle Controllers automatically operate the presses, from closing them through bumping, timing the cure, operating the valves in proper sequence and opening of the presses.

*Reg. U.S. Pat. Off.

Note the "off-the-press" location of all instruments on central panels. This gives more convenient access to working areas and enables operators to check performance at a central point. Better "housekeeping" and care of equipment also results.

To find out how you can profitably put Taylor to work in your plant, call your Taylor Field Engineer, or write Taylor Instrument Companies, Rochester, N. Y., or Toronto, Ontario.

Taylor Instruments

MEAN

ACCURACY FIRST

VISION · INGENUITY · DEPENDABILITY

William C. Martin

General Tire Names Martin

► General Tire & Rubber Co., Akron, Ohio, has named William C. Martin as manager of its Mogadore, Ohio chemical plant. In other appointments, Paul J. Early was named production superintendent of the Mogadore plant, and William R. George was transferred from his position as general foreman at the company's Ashtabula, Ohio plant to the same post at Mogadore. Mr. Martin, formerly production superintendent of the Mogadore plant, joined General Tire in 1952. He is a graduate of Lehigh University, holding a chemical engineering degree, and a member of the American Chemical Society.

Mr. Early has been associated with General Tire since 1950 when he joined the company's Research Department. He earned his degree in chemistry at Duquesne University and is a member of the American Chemical Society. Mr. George has a chemical engineering degree from Bucknell University. After working for four years as a sales engineer for Sprout, Waldron & Co., he joined General Tire in 1954.

Sinclair Chemicals Names Vance

► Sinclair Chemicals, Inc., a subsidiary of Sinclair Oil Corp., New York, N. Y., has appointed John W. Vance, formerly district sales representative in Philadelphia, as assistant sales manager in charge of chemical sales. Mr. Vance will be headquartered in New York City. A native of Cincinnati, Ohio, he received his B. A. degree in chemical engineering from the University of Cincinnati and later attended Temple University and Drexel Institute. He entered the United States Army in 1942 and served with the Third Army in Europe, attaining the rank of captain. In 1947, Mr. Vance entered the Technical Service Department of the Mead Corp., Philadelphia, Penna., and from 1948 to 1954, he was employed as a chemical buyer for Rohm & Haas Co., Philadelphia, Penna. He joined Sinclair Chemicals in 1955 as a district sales representative in Philadelphia.

Seiberling Plans Stock Issue

► Seiberling Rubber Co., Akron, Ohio, has asked the Securities and Exchange Commission for authority to issue 106,841 more shares of common stock in a move to raise additional funds. Present stockholders will be given the right to subscribe for the new stock at the rate of one new share for each four held. The subscription price will be determined immediately before the offering. Seiberling common closed at $19.62½, on December 22, on the New York Stock Exchange, about the year's high. At that price, the company would net close to $2 million by the sale of stock.

Seiberling's last annual financial report showed it had 427,364 shares of common stock outstanding. In addition, the company has 22,633 shares of 4½ per cent cumulative prior preferred stock and 18,792 share of 5 per cent cumulative class A preferred. If the registration statement, which was filed on December 23, receives SEC approval, the company planned to submit the offer to stockholders about January 19, with February 4 as the deadline for acceptance. The offering is being underwritten by a group of investment banking firms.

TLARGI Elects Officers

► The Los Angeles Rubber Group has announced the election of the following officers for 1959: *Chairman,* Charles Kuhn (Master Processing); *Associate Chairman,* B. R. Snyder (R. T. Vanderbilt); *Vice-Chairman,* W. M. Anderson (Gross Manufacturing); *Treasurer,* Howard Fisher (W. J. Voit); *Assistant Treasurer,* L. W. Chaffee (Ohio Rubber); *Secretary,* C. M. Churchill (Naugatuck Chemical); *Assistant Secretary,* J. J. Stetina (Tri-Angle); *Directors,* C. E. Huxley (Enjay Co.); R. O. White (Caram Mfg.); A. J. Hawkins (Du Pont); A. L. Federico (C. P. Hall); J. L. Ryan (Shell Chemical); and W. J. Haney (Kirkhill Rubber).

The TLARGI Annual Christmas Party was held at the Beverly Hilton Hotel on December 12, 1958 with 706 members and guests in attendance. The highlight of the party was a grand drawing offering a trip for two to Hawaii, which was won by Mr. & Mrs. Daryel Johnson (Latex Products).

Odor Control Materials

► Rhodia, Inc., 60 East 56 St., New York, N. Y., has announced the development of three new products for the correction of strong odors present in polyurethane foams. These products are "Alamask RLT 482", "RLT 483" and "RLT 28". The company reports that they are generally employed at concentrations of .03 per cent or less and are added directly prior to the addition of the catalyst. According to Rhodia, all the products are designed to withstand conditions of processing.

Clarence E. Clark

Relocates Company Office

► Clarence E. Clark, president of Whittaker, Clark & Daniels, Inc., New York, N. Y., has announced the relocation of the company's New York office to 100 Church Street, New York City. The move provides for modern office facilities in the new Church Street Building, which have been expanded and will enable the company to offer improved customer service to the cosmetic, ceramic, paint, rubber and other industries to which Whittaker products are distributed.

N.Y. Holds Xmas Party

► Approximately 500 members and guests of the New York Rubber Group attended the Annual Christmas Party held on December 12 at the Henry Hudson Hotel in New York City. The celebration got under way at 5:30 P.M. with a cocktail hour which was followed by the serving of dinner. A program of entertainment featuring music and various acts was presented. At the conclusion of this part of the program, over 100 valuable prizes were distributed. The distribution of the prizes was made possible by the contributions of 99 suppliers.

Union Carbide Buys Plant

► Union Carbide Corp., New York, N. Y., has announced that it has exercised its option to purchase from Amoco Chemicals Corp., the utilizable facilities which remain on a 306 acre tract at Brownsville, Texas, site of the processing plant formerly operated by Amoco. The option also includes the 42 mile Weslaco-Brownsville natural gas pipeline. Union Carbide is negotiating a long term lease with the Brownsville Navigation District for the Brownsville tract. According to the company, engineering studies will be made for additions and revisions at the site and operations will be carried on by Union Carbide Chemicals Co. and Union Carbide Olefins Co., both divisions of Union Carbide Corp.

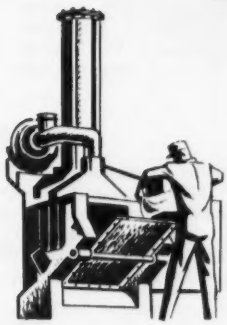
CUT COSTS BOTH WAYS *with* PROTOX®-166 ZINC OXIDE

1. Cut Handling and Storage Costs

Protox*-166 is dense. It bulks only about half that of conventional zinc oxides.

Thus you can handle Protox-166 faster and store it in a smaller space.

2. Cut Processing Costs



Protox-166 is outstanding for dispersion. It disperses readily in any rubber under any weather conditions . . . because it is free of aggregates and its particles are coated with zinc propionate that is readily wet by rubber.

Protox-166 is outstanding for calendering and extruding. It provides smoother calendering with less shrinkage, smoother extruding with less die swell, and longer runs on strainers.

Thus you can cut processing time and step up output with Protox-166.

* U. S. Patents 2,303,329 and 2,303,330

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Financial News

Firestone Reports Decline In 1958 Sales-Earnings

► Firestone Tire & Rubber Co., Akron, Ohio, has announced, in its annual report to stockholders, an 8.4 per cent drop in sales in 1958 with net sales amounting to $1,061,590,801 compared with $1,158,884,304 for 1957. The decline in total sales was caused largely by lower production in the automotive industry, which reduced the demand for original equipment tires, rims, foam rubber cushions and other automotive products. However, sales of replacement tires for 1958 were the greatest in the company's history, company officials state.

Net income for the year ending November 1, was $53,751,650 equal to $6.36 per share of common stock, compared with $61,692,152 for 1957 which was equal to $7.49 per share of common. However, fourth quarter net profit was the highest of any quarter in the company's history, amounting to $18,633,000 which is equivalent to more than 50 per cent of the earnings for the first nine months of 1958.

Foreign subsidiaries' profits of $15,070,768 were lower than 1957, principally due to the depreciation of certain foreign currency. This also necessitated devaluation of assets of certain foreign subsidiaries, which resulted in a charge of $5,412,978 to a reserve provided from income in prior years.

During the fiscal year, Firestone paid dividends of $2.60 per share of common stock, and an extra dividend in the form of a stock dividend of 2 per cent on the common.

During 1958, the company retired $4,550,000 of long term debt and $1,200,000 of preferred stock. Net working capital at the close of the year was $359,961,160 compared with $329,064,436 on October 31, 1957, a gain of $30,896,724.

The report also disclosed that Firestone paid out in Federal, state and foreign taxes a total of $130,039,948, of which income taxes were $53,450,000; excise taxes $61,158,715; social security taxes $6,069,595; and other taxes $9,361,638.

Cash expenditures for additions and improvements to plant and equipment amounted to $37,766,473 compared with $68,768,620 for 1957. Manufacturing capacities were increased in Firestone plants at Des Moines, Iowa; Orange, Texas; Hamilton, Ontario; Brentford, England; Sao Paulo, Brazil; Bombay, India; and Port Elizabeth, South Africa. Additional warehouse facilities were constructed at Lake Charles, La.; Hamilton, Ontario; and St. Louis, Mo.

Goodyear

► Nine months ended September 30: Estimated net income was $47,452,796, equal to $4.48 per share of common stock, compared with $51,621,653, or $4.87 per share in the corresponding period last year. Sales in the first nine months totaled $1,001,677,845, compared with $1,082,499,729 reported for the first nine months of 1957.

General Cable

► Nine months ended September 30: Net income of $4,803,938, equal to $1.60 per share of common stock, compared with $9,156,273, equal to $3.15 per share of common in the same period of 1957. Gross profit on sales for the first nine months totaled $16,784,861, compared with $25,456,602 in the same period of 1957.

Armstrong Rubber

► Year ended September 30: Net income of $3,227,756, which is equal to $2.08 per share of common stock, compared with $2,950,423, or $1.90 per share, for the like period of 1957. Net sales for the year amounted to $81,317,403, a 6.8 per cent increase over net sales of $76,137,429 reported for 1957.

American Zinc, Lead & Smelting

► Nine months to September 30: Net income of $719,354, which is equal to 61c per common share, compared with $909,901, or 77c a share, in the equivalent period last year. Sales in the first nine months of this year totaled $30,579,306, compared with $47,294,788 during the 1957 three-quarter period.

U. B. S. Chemical

► Six months to June 20: Net income of $81,157, which is equal to 50c per share, compared with $188,101, or $1.54 a share, in the corresponding six months of 1957. Sales in the first six months of this year totaled $2,391,728, compared with $2,751,589, during the same period last year.

Rubbermaid

► Year ended September 30: Net income amounted to $1,135,037, equal to 92c per share of common stock, a seven per cent raise over the income of $1,061,306, or to 86c per share, in 1957. Net sales for 1958 totaled $21,474,805, compared with $21,100,472 in 1957.

Kerite

► Six months to June 30: Net income of $219,405, which is equal to 86c per common share, compared with $605,860, or $2.37 a share, in the corresponding six months of 1957. Sales in the first half of this year totaled $4,036,296, compared with $6,649,415, in the 1957 first half.

Swan Rubber

► Year to July 31: Net income of $785,210, which is equal to $1.06 per share, compared with $1,003,337, or $1.35 a share, last year. Sales in fiscal 1958 totaled $17,249,366, compared with $18,832,718 in 1957.

Aetna-Standard

► Year to June 30: Net income of $1,236,795, which is equal to $2.44 per common share, compared with $1,418,741, or $3.07 a share, in fiscal 1957. Sales and other income in fiscal 1958 totaled $31,301,279, compared with $43,411,427 last year.

Sheller

► Nine months ended September 30: Net loss, after tax credit, of $458,633, with no earnings for common shares, compared with a net income of $1,511,993, equal to $1.59 per share of common for the same period of 1957.

McNeil Machine

► Nine months to September 30: Net income was $1,147,359, earning $1.80 per common share, compared with $2,542,363, equal to $4.21 per share of common stock in the same period last year.

Rome Cable

► Six months to September 30: Net income of $112,000, equal to earnings of 20c per share of common stock, compared with $703,000, equal to $1.26 earned per share of common for the same period of 1957.

Pantasote

► Nine months ended September 30: net profit of $57,000 against a loss of $60,000 for the first half of 1958.

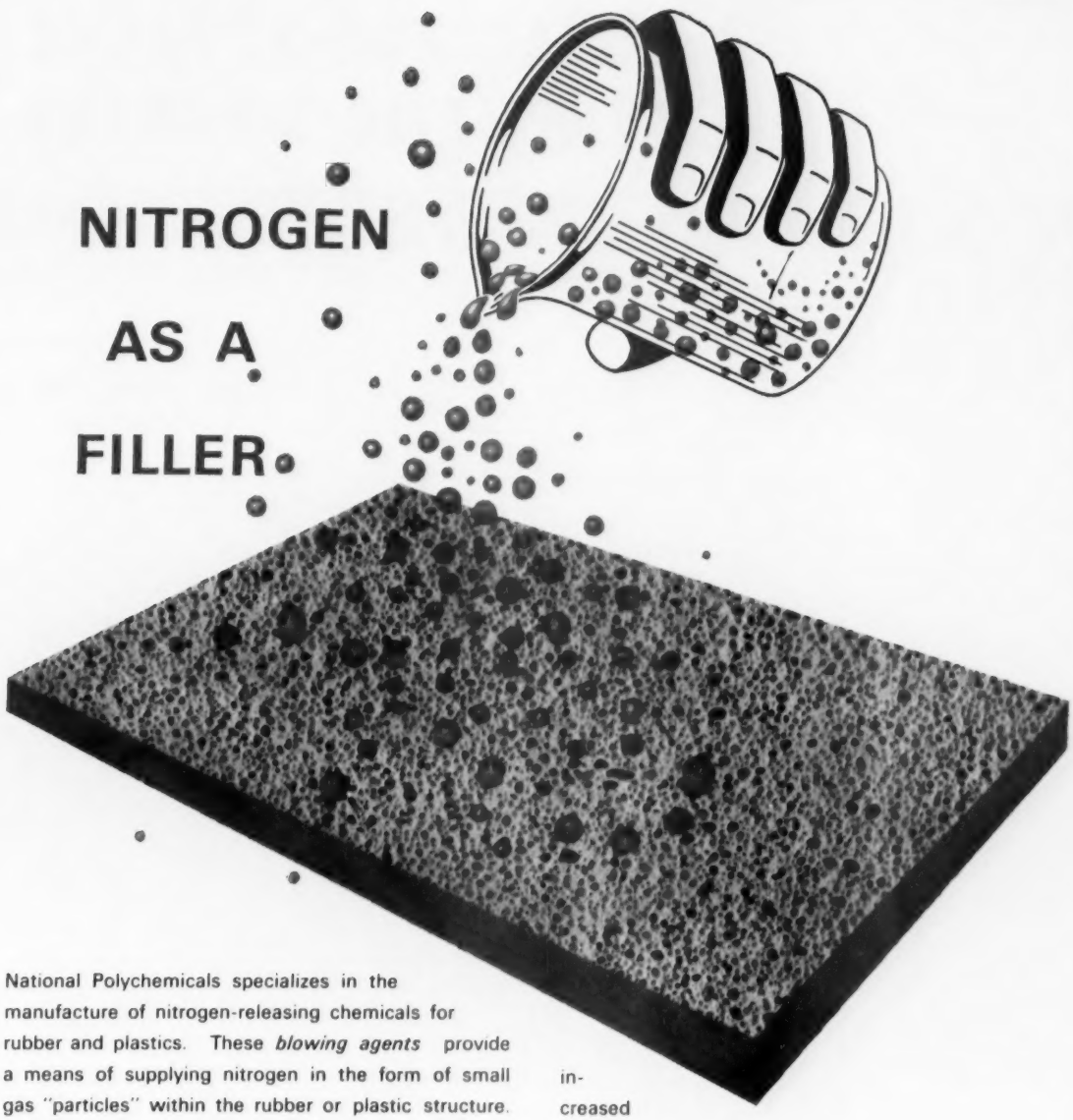
DeVilbiss

► Nine months ended September 30: Net income of $424,947, equal to $1.17 per share of common stock, compared with $1,225,782, equal to $3.30 per share for the same period of 1957.

Belden Mfg.

► Nine months to September 30: Net income of $422,850, equal to $1.08 per share of common, compared with $974,943, equal to $2.50 per share of common for the same period last year.

NITROGEN AS A FILLER



National Polychemicals specializes in the manufacture of nitrogen-releasing chemicals for rubber and plastics. These *blowing agents* provide a means of supplying nitrogen in the form of small gas "particles" within the rubber or plastic structure. Regardless of what you manufacture, you should investigate the possibilities of improving your product or lowering your cost by this technique.

This is a new and exciting concept in the compounding of rubber and plastics. Whatever your objective – lower volume cost, lower hardness, better thermal or electrical insulation characteristics, improved cushioning properties, reduced weight or increased buoyancy – you should give consideration to this new approach in the formulation of your stocks.

As specialists in this field, we are ready to assist you in the use of nitrogen as a new compounding ingredient. To get started, write to us today for technical "know-how", together with samples of our nitrogen-releasing chemicals, OPEX 40 and KEMPORE R-125.

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Wilmington, Massachusetts

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BUTADIENE-STYRENE SYNTHETIC RUBBERS

HOT TYPES

SYNPOL	1000	1001	1002	1006	1007	1009	1012	1013	1061
DESCRIPTION									
Emulsifier	Fatty Acid	Fatty Acid	Rosin Acid	Fatty Acid	Fatty Acid	Fatty Acid	Fatty Acid	Fatty Acid	Fatty Acid
Stabilizer	Staining	Slightly Staining	Staining	Non-Staining	Staining	Non-Staining	Non-Staining	Non-Staining	Non-Staining
Miscellaneous				Non-Discoloring	Glue Acid coagulated	Non-Discoloring Divinylbenzene Terpolymer	Non-Discoloring	Non-Discoloring Alum Coagulated High styrene	Non-Staining
Carbon Black									
SPECIFICATIONS CHEMICAL									
Volatile Matter (Max.)	0.50	0.50	0.50	0.50	0.50	0.75	0.50	1.00	0.50
Ash (Max.)	1.50	1.50	1.50	1.50	0.50	1.50	1.50	1.25	1.50
Organic Acid	4.00–6.25	4.00–6.25	3.75–6.00	3.75–6.00	3.75–6.00	3.75–6.00	4.25–6.50	4.00–6.00	4.00–6.25
Soap (Max.)	0.75	0.75	0.75	0.75	0.25	0.75	0.50	0.01	0.75
Bound Styrene	22.5–24.5	22.5–24.5	22.5–24.5	22.5–24.5	22.5–24.5	22.5–24.5	22.5–24.5	42.0–44.0	22.5–24.5
Stabilizer	1.00–1.75	1.00–1.75	1.00–1.75	1.25 added	1.00–1.75	1.25 added	1.25 added	1.25 added	1.25 added
Carbon Black									
PHYSICAL									
Raw Viscosity	44–52	44–52	50–58	46–54	45–55		95–115	40–50	44–52
Cpd. Viscosity (Max.)	73	73	65	73	73	115–135	120	73	73
Tensile psi (Min.)	2700	2500	2700	2500	2400	1600	2900	2500	2500
Elongation % (Min.)	550	500	550	500	500	300	450	600	500
#Modulus psi 25′	300–600	325–625	300–600	400–700	450–750	400–700**	550–1000	350–750	325–625
#Modulus psi 50′	800–1150	750–1100	750–1100	825–1175	775–1125	600–950**	1200–1700	775–1175	750–1100
#Modulus psi 100′	1250–1650	1200–1600	1125–1525	1300–1700	1125–1525	850–1250**	1750–2250	1250–1750	1200–1600
Water Soluble Ash % (Max.)					0.35				
Water Absorption mg./sq. cm. (Max.)					1.50				
Mill Shrinkage % (Max.)						25.0			
Oil—Parts									
Oil—Type									
REMARKS	A general purpose hot rubber adaptable to most black products where color is unimportant.	More resistant to staining and discoloring than 1002.	Higher tensile and lower modulus in cured compounds than 1000 or 1001. Slower curing.	General purpose, non-discoloring and non-staining polymer.	Glue acid coagulated staining polymer with relatively low water absorption, low ash, and good electrical properties.	A non-staining cross linked polymer. Use of small quantities with other type polymers reduces shrinkage and die-swell in calender and extrusion operations.	A high-Mooney polymer for solution applications.	A high styrene, non-staining and non-discoloring polymer.	Similar to 1006, with Polygard stabilizer.
APPLICATIONS	Tires, molded and extruded mechanical goods, shoe soles and heels, and any other general purpose application.	Tires, molded and extruded mechanical goods, shoe soles & heels.	Tires, molded and extruded mechanical goods.	Light-colored and white products, such as white sidewall tires, shoe soles, floor tile, toys, hospital sheeting, sporting goods.	Wire and cable insulation, electrical tape, gaskets, hard rubber products, etc.	Where control of shrinkage is important. Footwear, wire & cable insulations, calendered goods, soles, heels. Can be used with Natural Rubber and Neoprene.	Asbestos sheet packing. Special types of adhesives and certain mechanical goods.	Calendered goods, closures, can sealants, adhesives and molded goods.	Light-colored & white products such as white sidewall tires, shoe soles, floor tile, toys, hospital sheeting, sporting goods.

†Based on rubber hydrocarbon content #300% Elongation **Synpol 1009 Moduli @ 200% Elongation

HERE ARE THE 4 LATEST NEW SYNPOLS

SYNPOL 8000 Hot, high styrene (43 parts) • non-staining, non-discoloring premium rubber at regular price

SYNPOL 8200 Extremely light-colored • non-staining, non-discoloring—37.5 parts pale naphthenic oil • low ash content

SYNPOL 8201 Light colored • 50 parts naphthenic oil • low ash content

SYNPOL 8253 Black Masterbatch • 60 parts FEF • 37.5 parts naphthenic oil • non-staining

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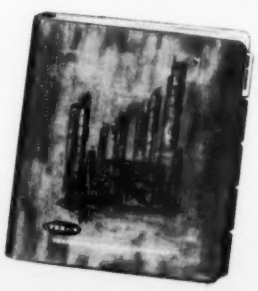

Have you thoroughly considered SYNPOL?

- There are now 24 different grades of SYNPOL—a quality rubber to meet any product or process need.
- TEXUS offers the widest line of clear polymers in the industry.
- New SYNPOL ultra-dispersed black masterbatches are already commercially proven and available in full commercial quantities.
- The industry's most extensive warehousing operation assures when-you-want-it delivery that is unsurpassed.
- TEXUS technical service, backed by extensive basic and applied research programs, offers immediate, experienced assistance with your product or process problems.

Whatever your product, present or contemplated, whatever your process needs, if you want to be sure you are giving yourself every possible advantage, better consider SYNPOL thoroughly—now. For further information, technical literature, or to have a TEXUS Representative contact you at your convenience, simply pick up the phone and call collect. The number is MUrray Hill 9-3322 in New York.

	COLD TYPES			COLD OIL-EXTENDED TYPES					BLACK MASTERBATCHES		
	1500	1502	1551	1703*	1707*	1708*	1711	1712	8150	8250	8251
	Rosin Acid Staining	Mixed Soap Non-Staining Non-Discoloring	Rosin Acid Non-Staining Non-Discoloring	Mixed Soap Non-Staining Non-Discoloring	Rosin Acid Non-Staining Non-Discoloring	Fatty Acid Non-Staining Non-Discoloring	Rosin Acid Staining	Mixed Soap Staining	Rosin Acid Staining	Mixed Soap Staining	Rosin Acid Staining
									Acid Coagulated	Acid Coagulated	Acid Coagulated
									50 pts. HAF Ultra-Dispersed	50 pts. HAF Ultra-Dispersed	75 pts. HAF Ultra-Dispersed
											(Typ. Prod. Values)
	0.75 1.50 5.00–7.25 0.50 22.5–24.5 1.00–1.75	0.75 1.50 4.75–7.00 0.50 22.5–24.5 1.25 added	0.75 1.50 5.00–7.25 0.50 22.5–24.5 1.25 added	0.75 1.50 4.50–6.30 0.50 22.5–24.5 1.25 added†	0.75 1.50 3.90–5.70 0.50 22.5–24.5 1.25 added†	0.75 0.50 3.90–5.70 0.50 22.5–24.5 1.25 added†	0.75 1.50 3.90–5.70 0.50 22.5–24.5 1.25 added†	0.75 1.50 3.90–5.70 0.50 22.5–24.5 1.25 added†	1.00 0.50 3.25-4.75 0.50 1.25 added 32.4-34.2	1.00 0.50 3.20-4.50 0.40 1.25 added 27.2-29.9	1.00 0.50 1.25 added 33.9-36.6
										Typ. Prod. Range	
	46–58 73 3800 600 300–650 800–1200 1200–1700	46–58 73 3100 575 350–650 775–1125 1250–1650	46–58 73 3600 600 300–650 800–1200 1200–1700	50–70 25 Naphthenic	45–65 37.5 Naphthenic	50–70 0.35 1.50 37.5 Naphthenic	45–65 37.5 Highly Aromatic	45–65 37.5 Highly Aromatic	65-80 3000 350 1325-2125 1750-2650 2100-3100	55-70 2900 500 300-900 650-1350 900-1600 25 Highly Aromatic	 37.5 Highly Aromatic
	A general purpose cold rubber for use where color and staining is unimportant.	Non-discoloring and non-staining cold rubber. Higher physicals than 1006 and 1061.	A general purpose non-staining and non-discoloring cold rubber, based on recipe for 1500.	A general purpose non-discoloring, non-staining oil-extended polymer.	Similar to 1703. Emulsified with rosin soap rather than mixed soap.	Non-discoloring and non-staining polymer, low ash content and water absorption values, resulting in good electrical properties.	Similar to 1712, emulsified with rosin soap rather than mixed soap.	General purpose oil-extended polymer for use where color and staining is unimportant.	Rubber and Black are mechanically mixed for ultra-dispersion, resulting in significantly improved physicals, with clean handling and substantial mixing economies.		
	Tires, camelback, molded and extruded mechanical goods.	Light-colored & white products such as white sidewalls, white & light colored mechanicals, floor tile, hospital sheeting, toys, soles, heels, food conveyor belts.	For general use where non-staining characteristics are important.	Light-colored and white products; tires, mechanical goods, floor tile, shoe soles and heels, sporting goods and toys.	White sidewall tires, camelback, molded and extruded mechanical goods. Friction and skin coats. Molded shoe soles and heels.	Wire & cable insulation; certain electrical goods, coated fabrics, molded and extruded mechanicals, soles, heels, wringer rolls, floor tiles.	Tires and camelback. Molded and extruded mechanical goods.	Tires, camelback, molded and extruded mechanical goods. Wire and cable insulation.	Tires, camelback, shoe soles and heels, molded mechanical and sporting goods, wire and cable insulation, industrial rolls and wire coatings. Use of oil-extended grades 8250 and 8251 effects additional cost savings.		

*Improved light-colored, oil-extended polymers

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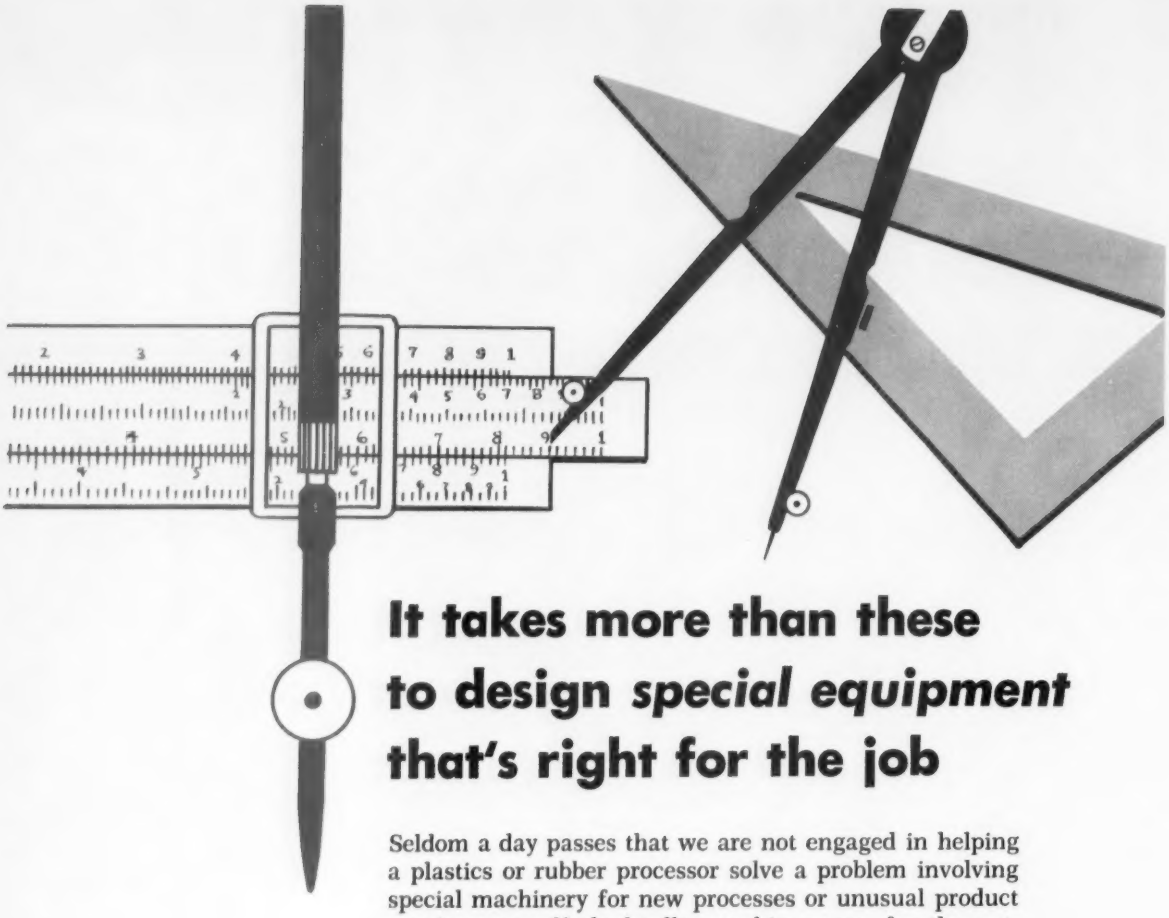
General Offices and Plants: Port Neches, Tex. TEXUS Research Center: Parsippany, N.J.



It takes more than these to design *special equipment* that's right for the job

Seldom a day passes that we are not engaged in helping a plastics or rubber processor solve a problem involving special machinery for new processes or unusual product requirements. Undoubtedly one big reason for the outstanding success of this phase of our business is that important extra "tool" Adamson United brings to the job . . . the wealth of specialized knowledge gained through more than 65 years of intimate contact with these industries.

Do you need special equipment for a new process? A new design to cut production costs, increase production or improve product quality? Our engineers, who are thoroughly familiar with today's plastics and rubber processing problems, have provided hundreds of manufacturers with equipment that meets these requirements exactly. Adamson United is ready to go to work for you, with a complete service from blueprint to installation. Why not call us in to discuss your particular problems? No obligation, of course.

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ADDITION

ADDITION—Calcene® CO, a new grade of calcium carbonate, is the latest of Columbia-Southern's outstanding Calcene pigments. You now have three from which to choose:

CALCENE TM (Original product) Surface-coated for fast and thorough dispersion.

CALCENE NC (Non-Coated) Better in color than TM, but slightly harder dispersing.

CALCENE CO (Coated) Clean white to provide true color values in finished goods.

ADDITION—Calcene may provide your rubber products with additional advantages required for better looks, better wear, better price. Use Calcene for pastel or colored goods . . . for improved hot tear resistance . . . for an equivalent high level of uniform physicals at greater economy compared with more costly ultra-fine carbonates. Local stocks provide fast service in Boston, Hoboken, Chicago and Los Angeles. For an **ADDITIONAL** idea in your operations, why not investigate Calcene now. Price information and formulation suggestions may be obtained by contacting your nearest Columbia-Southern office or by writing Room 1929A, One Gateway Center, Pittsburgh 22, Pennsylvania.

COLUMBIA-SOUTHERN CHEMICAL CORPORATION

A Subsidiary of Pittsburgh Plate Glass Company • One Gateway Center, Pittsburgh 22, Pennsylvania

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West Coast News

► Western Insulated Wire Co., Los Angeles, Calif., has announced additions to plant, equipment and technical staff. An addition to the main plant in Los Angeles has been built and equipped to manufacture "Teflon" insulated hook-up wires. Floor space of the Los Angeles warehousing facility has been doubled and synchrocuring equipment has been installed and is being used to vulcanize four conductor Bronco 66 Certified Type W cables as large as A.W.G. size 4/0.

Three chemists and engineers have been added to the technical staff, they are: Jan Visscher, a rubber chemist who previously was engaged in rubber research and development with Anaconda Wire & Cable Co.; Hugo Biskeborn, assigned to work on advanced cable design problems. He formerly was employed as technical director of Kaiser Aluminum and Chemical Corporation's cable plant, and director of manufacturing of Ansonia Wire & Cable Co.; and K. D. Champagne, a rubber chemist formerly with the Wire and Cable Division of Northern Electric Co.

► Executives of the B. F. Goodrich Tire Co. recently hosted a reception and dinner for some 300 dealers at the Biltmore Hotel in Los Angeles, Calif. A talk by L. T. Greiner, Pacific regional manager for the company, was one of the highlights of the evening. Mr. Greiner stated that the biggest tire market in the world—Los Angeles County—would not be likely to lose that position for many years. This year, industry retail sales of passenger, truck, and bus tires in Los Angeles County are expected to reach $38,878,000, based on estimated sales of 1,858,700 units and the total for California might reach $108,531,000. Mr. Greiner added "The continuing migration of car-owning families to this area each year should keep Los Angeles County the largest tire market in the world for years to come. Next year, replacement tire sales in the county are expected to show a 5 per cent increase over 1958."

► The California Division of The Pantasote Co., Passaic, N.J., has moved its headquarters from 2627 San Fernando Road, Los Angeles, Calif., to a new 20,000 foot warehouse at 4703 East 48 Street, Vernon, Calif. The new warehouse will enable the company to keep a minimum inventory of one-half million pounds of vinyl. Resins produced by the Eleonora Chemical Division of Pantasote will be stocked on the West Coast. Production of Pantasote's "Panta-Pak" trays is under way at the new headquarters.

► Chemicals-Pigments-Metals Division of the Glidden Co., Cleveland, Ohio, has established a revised method of distributing its products in the West Coast area. The division will channel all West Coast sales activities through its own offices at strategic locations there in order to more adequately serve customers in that area.

Ralph B. Quelos, eastern sales manager for the Chemicals-Pigments-Metals Division, with headquarters in Baltimore, Md., will also manage sales for this West Coast area. William Ellis will represent the division in the San Francisco vicinity and Fred Downer and M. Bonham will be responsible for the Los Angeles area. Warehouses containing full inventories of these products will be maintained and controlled in both the Los Angeles and San Francisco Bay area.

► L. L. Horchitz, formerly Los Angeles district manager for the B. F. Goodrich Industrial Products Co., has retired from the rubber firm, ending a 42 year career. Considered one of the best informed men of the use of rubber in industrial applications, Mr. Horchitz started as a sales correspondent in the company offices at Akron, Ohio, in 1916. Shortly afterwards, he was named assistant to the district manager in New York City and in 1922, he moved to a sales post in the company's Los Angeles district. He was appointed manager of the Pacific Northwest district at Seattle in 1928. Later that year, he returned to Los Angeles as coast manager of B. F. Goodrich industrial products sales. Since 1957, Mr. Horchitz has been on special assignment representing company management. He is a past president of the Los Angeles Rubber Group.

► H. C. Lien Rubber Co. has announced the appointment of L. J. Lien, who was formerly associated with Rubberite Corp., as plant manager and an officer of the company.

► Gene Huxley, of the Enjay Co., has been elected a director of the Rubber Division of the American Chemical Society, representing the Los Angeles area.

► Robert L. "Bud" Feldman has been elected executive vice-president of the Golden Bear Oil Co., Los Angeles, Calif.

► Kraco Industries, Inc., has announced the appointment of William Skagg as plant manager for the firm.

Walter P. Hwozdek

Hwozdek Appointed Manager

► National Polychemicals, Inc., Wilmington, Mass., has announced the appointment of Walter P. Hwozdek as development manager. Mr. Hwozdek joined the firm's research and development staff in October, 1954. He is a graduate of Polytechnic Institute of Brooklyn and previously has been associated with Air Reduction Chemical Co. He had also been with Ethicon Suture Laboratories and Merck & Co. Mr. Hwozdek is a member of the American Chemical Society.

► New Jersey Zinc Co., New York, N. Y., has established a new sales district area on the West Coast, with offices in Los Angeles, Calif., in order to provide better service to customers in this area. John S. Collbran, Jr., formerly western district manager at the company's Chicago sales offices, has been transferred to Los Angeles as Pacific district manager. James P. Sheridan, manager of pigment sales in the western district, will succeed Mr. Collbran as western district manager.

Mr. Collbran is a native of California and served as an officer in the U. S. Army during World War II. He joined the company in 1945 as a representative in the Los Angeles office. In 1949, he was transferred to Chicago and he became manager of that office in 1954. Mr. Sheridan has been in the service of the company for more than 35 years and for the past 22 years, he has been a sales representative in the pigment field.

► Fred Case, formerly associated with Kirkhill, and Percy Burdick, previously with Triangle Tool and Machine Co., have joined Gill Electric Manufacturing Corp., Redlands, Calif., in the formation of the Gill-Case Corp. at 630 West 17th St., Costa Mesa, Calif. The new firm will manufacture molds, tools and special machines and will also do some rubber molding, primarily for Gill Electric.

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New Polyurethane-type rubber

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Consider these advantages of products derived from this stock

- VERY GOOD OZONE RESISTANCE
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- REMARKABLE HEAT RESISTANCE
- OUTSTANDING ABRASION RESISTANCE

If you're looking for rubber stock with unique qualities to solve tough product requirements, Genthane-S may offer an easy solution to your problem. Combining excellent ozone, oil, heat and abrasion resistance with ability to be processed on existing equipment, this stock has numerous applications in specialty-compounding . . . for example, industrial tires, footwear, valve diaphragms, impellers, grommets and oil field supplies. Genthane-S polyurethane elastomer is available in semi-commercial quantities now. Send for a sample shipment and complete literature today!

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CHEMICAL DIVISION, DEPT. A

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Chemical Division GENERAL THE GENERAL TIRE & RUBBER CO

Canadian News

► Polymer Corp., Ltd., has appointed E. J. Buckler, formerly manager of its Research and Development Division, as vice-president of research and development. Born in Birmingham, England, Dr. Buckler received his M.A. and Ph.D. degrees at the University of Cambridge. Following graduation, he worked as a research chemist in the petroleum industry, first with Trinidad Leaseholds, Ltd., and later with Imperial Oil, Ltd. During the war years, he was loaned to St. Clair Processing Corp., a subsidiary of Imperial Oil, Ltd., which was formed to operate the petrochemical and butyl rubber plants administered by Polymer. In the capacity of a petroleum engineer and later as technical superintendent, he was primarily concerned with the technical aspects of preparation of light hydrocarbons and the manufacture of butyl rubber.

Dr. Buckler was also loaned for work in the same field to the Chemical Products Division of the Standard Oil Co. of Louisiana. He is the author of many papers, which he has presented before technical conferences in Europe as well as America. He is a member of the American Chemical Society, the American Institute of Chemical Engineers, the Society of the Chemical Industry, and is an associate of the Royal Institute of Chemistry. He has also held various offices in the Sarnia section of the Chemical Institute of Canada, of which he is a fellow.

Polymer Corp., Ltd., has also appointed J. T. Black, previously assistant sales manager, to the position of general sales manager. Mr. Black, who was born in Prince Edward Island, received his B.Sc. degree from Mount Allison University in 1942 and immediately entered the service of the Dominion Rubber Co., Ltd., in Montreal, where he did product development work. In 1946, he joined Polymer as a technical service representative and during his career with the sales division, he has travelled extensively for the company in Europe, Japan and South America. Mr. Black is a member of the Chemical Institute of Canada and is past chairman of the Rubber Division of the Institute.

► The United Kingdom Board of Trade has classified polyethylene, polyvinylchloride, polystyrene and polymethyl methacrylate, as being outside the protection of the British Key Industries Act. This act gives free entry to "synthetic organic chemicals" from Commonwealth sources and puts a 33-1/3 per cent duty on these chemicals if they originate from other sources. According to a Board of Trade Tribunal, these items are not synthetic organic chemicals within the meaning of the act. These polymers will continue to enter the United Kingdom free from Commonwealth countries, including Canada, but protection against other sources is now only 10 per cent.

The case was taken to the Board of Trade by four British chemical manufacturers, including Bakelite, Distillers, Imperial Chemical Industries and Monsanto Chemicals, who were alarmed by increasing polymer imports from Japan and Italy. Because they had expected a decision in their favor—which would have reserved the British market largely to themselves and Canadian manufacturers—British chemical manufacturers planned additional capacity in this sector of plastics production.

► Marketing Division of Polymer Corp., Ltd., has announced several organizational changes including the appointment of J. T. Fitzgerald, S. C. Kilbank and T. L. Davies as area sales managers. E. E. Gale has been named supervisor, technical services, and W. W. Winskill, supervisor, commercial services. Mr. Fitzgerald will be sales manager for Latin America, the Far East and Australasia. He joined Polymer in England in 1948 as European technical service representative with headquarters in London, England. Since 1955, he has been located in the company's Sarnia office and in 1956, he was appointed a sales supervisor.

Mr. Kilbank, who has been appointed area sales manager for Europe, the Middle East and Africa, joined polymer as a chemist in copolymer products. In 1950, he transferred to the Sales and Technical Service Division and in 1955, he succeeded Mr. Fitzgerald in London, England. Mr. Kilbank was appointed sales supervisor in 1956. Mr. Davies will service as area sales manager for Canada and the United States. He became associated with the company as a chemist in the copolymer area in 1943. He was supervisor of the emulsion polymerization pilot plant before he transferred to the Sales and Technical Service Division early in 1949. In 1956, he was appointed sales supervisor.

Mr. Gale joined Polymer late in 1950 and was associated with copolymer development in pilot plant work with the company's Research and Development Division for three years. In 1953, he joined the Sales and Techincal Service Division. Mr. Winskill was formerly supervisor of the Order Section of the Marketing Division. He joined Polymer in 1949 and, after a short stay in the Technical Service Section, he transferred to the Marketing Division.

P. E. Albert Forms Firm

► P. E. Albert, for many years vice-president of the original firm of L. Albert & Son, dealers in new and used rubber and plastics machinery and equipment, and until recently general manager of the Machinery Division of the Bellanca Corporation, has formed P. E. Albert & Son. Headquarters of the new company will be maintained at 21 Nottingham Way, Trenton 21, N. J. The company has purchased the Trenton facilities, some of their inventory and all of their spare parts from the L. Albert & Son Division of the Bellanca Corporation. The acquisition of the spare parts was done mainly as a service to the rubber industry. The Bellanca concern is currently conducting a liquidation sale for its used rubber and plastics machinery. Associated with Mr. Albert in the new organization, is the same staff which has worked with the Albert organization in the Trenton territory for many years. In announcing the formation of the new company, Mr. Albert stated: "It is with a great deal of pride and personal satisfaction that I find myself once again engaged in serving an industry that has been so well served by my family for the past fifty years."

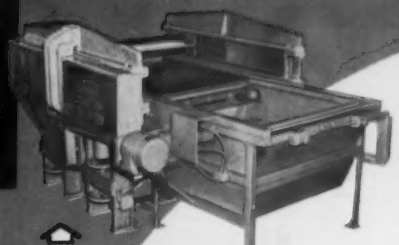
Okonite Acquires New Division

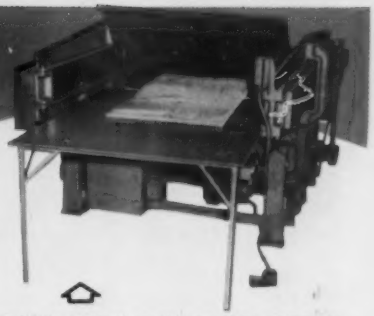
► Okonite Co., a subsidiary of Kennecott Copper Corp., Passaic, N. J., has announced that the Kennecott Wire & Cable Co. has become an operating division of the company. R. Stuart Keefer, president of Okonite, states that when Kennecott Copper purchased Okonite, it also acquired a second wire and cable subsidiary. A decision was reached to combine the two operations in order to perform the most effective job of competing in all phases of the wire and cable industry. Kennecott Wire & Cable Co. will be known as the Okonite Co., Kennecott Wire & Cable Division. A. F. Sheldon, head of Kennecott, will serve as administrative executive at the Phillipsdale plant, reporting to Mr. Keefer. Operations at Phillipsdale will continue to be handled by the present staff.

► Kelly-Springfield Tire Co., Cumberland, Md., will begin operations in Ontario under the name of the Kelly-Springfield Tire Co. of Canada, Ltd. Fred Thornton, vice-president and managing director, will head the newly established company. Mr. Thornton has had many years of tire sales, managerial, and administrative experience in both Canada and England. His most recent position was as retail sales manager for Simpsons' Sears Automotive Products. A fully-staffed Sales Department, headed by Orville Orendorff, formerly of Firestone, will assist Mr. Thornton. Canadian offices are located at 188 University Ave., Toronto, Ont.

FEMCO

1959 LINE





HEAVY DUTY ROLLER DIE CUTTER with Vertical Die Handling Mechanism

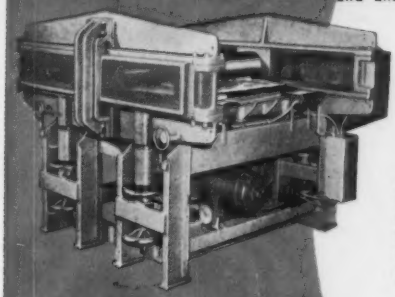
The ideal equipment for trimming and die cutting parts from sheet or roll stock. Frictional drag of stock over dies is eliminated; concavity on side cuts and stretch of stock greatly reduced. Trim dimensions are accurate and heavy gage stock can be cut.

FEMCO BUILT and CAMPBELL DESIGNED

HEAVY DUTY ROLLER DIE CUTTER with Horizontal Die Handling Mechanism

Dies move automatically on and off bed for easy loading and unloading. Mechanism especially adapted for working with small parts in sheets made from open and closed cell sponge, vacuum formed plastics, uncured sponge rubber, cork, urethanes, supported and unsupported vinyl sheeting.

ROLLER
DIE CUTTERS
and
AUTOMATIC
TRIMMERS

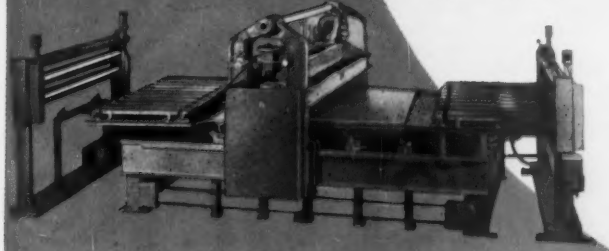


HEAVY DUTY ROLLER DIE CUTTER Standard Model

24 sq. ft. bed area. Cuts floor mats, rubber or cork gaskets, leather, sponge rubber, uncured rubber, plastic foams, etc. Uses inexpensive steel rule dies.

AUTOMATIC ROLL FEED ROLLER DIE CUTTER

Indexes stock automatically, built especially to die cut and trim parts from rolls. Dies are mounted on bed or in frame above bed. Cuts latex foam, sponge rubber, foil, felt, Sissal, textiles, supported and unsupported vinyl sheeting. A complete cutting cycle every 10 seconds.



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Trims an entire sheet of Molded Rubber goods right from the Mold. Has trimmed up to 960 pieces a minute. Eliminates 'double compression' cutting. Trims natural and synthetic foam, cardboard, closed and open cell sponge, vacuum formed materials, rubber, cork, etc. Fastest, cleanest method of trimming available today.

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Obituaries

Paul B. Pew

► Paul B. Pew, executive vice-president for the Linde Air Products Division of Union Carbide Corp., New York, N. Y., died on October 11 in Doctors Hospital, New York City, of lung cancer. He was 60 years old. Mr. Pew, who was in charge of sales production and research activities, had been with Union Carbide for thirty-five years. A native of Chicago, Mr. Pew joined the company in 1923 after having graduated as a mechanical engineer from the University of Michigan. Within five years, he was superintendent of the Gas Plants Division.

Mr. Pew transferred to New York headquarters in 1930 as assistant to the general superintendent and subsequently became assistant works manager and works manager. In 1944, he was named a vice-president and was put in charge of gas production. He took charge of all production in 1951 and became executive vice-president three years ago. Earlier at Linde, he had been one of the developers of a process for producing and distributing Driox, oxygen in liquid form, which process the company introduced in 1928. During World War II, Mr. Pew was one of several Linde executives brought into the Manhattan District project, which developed the atomic bomb. He is survived by his wife and two sons.

Earl J. Farlow

► Earl J. Farlow, founder and owner of the Farlow Rubber Supply, Los Angeles, Calif., died suddenly at Queen of Angels Hospital, Los Angeles, Calif., on October 1, following a cerebral hemorrhage. Born at High Point, N. C., Mr. Farlow went to Los Angeles in 1935. For some years, he was associated with Brown-Muth Rubber Co., and in 1948 he established his own firm which was engaged in the manufacture of solid industrial tires and specialized in bonding rubber to metal. He operated this organization as sole owner until his death. He is survived by his wife.

Howard G. Strauss

► Howard G. Strauss, president of the Allied Latex Corp., Haskell, N. J., died recently at the Monmouth Medical Center from a heart ailment. He was 60 years old. In addition to heading the Haskell firm, Mr. Strauss was president of the Ardell Razor Blade Corp., Newark, N. J., and a director of the Tishman Realty Co., New York, N. Y. Surviving are his wife, a son and a daughter.

Carl D. Smith

► Carl D. Smith, manager of the Special Purpose Tire Sales Department for the General Tire & Rubber Co., Akron, Ohio, died on November 19 in Huron Road Hospital, Cleveland, Ohio. He was 62 years old. Mr. Smith was a native of East Liverpool and was graduated from Cornell University. After service in World War I, he joined the B. F. Goodrich Co. and four years later became associated with the Firestone Tire & Rubber Co. He took the General Tire post in 1953, after a short real estate career in Pasadena, Calif.

Mr. Smith, who was deeply concerned with safety work, had been working full-time for six months before his death as General Tire's representative in the National Vehicle Safety Check Program. He also served with the Ohio Voluntary Safety Inspection Program and was chairman of the legislation committee of the Summit County Safety Council. Mr. Smith was a member of several civic and social organizations. He is survived by his wife and two sons.

Alfred J. Baker

► Alfred J. "Al" Baker, manager of rubber thread sales for B. F. Goodrich Industrial Products Co., died of a heart attack on September 23 at his home in Akron, Ohio. He was 58 years old. He joined the company in 1927 as manager of the DuBois, Penna., plant which processes rubber thread and thread products. Mr. Baker had been a general foreman in the Akron plant and later became a production manager in Industrial Products. He had also served as administrator of the War Production drive committee in Akron and at one time was manager of factory personnel. Mr. Baker was born in Mercer, Penna., and attended Ohio Northern University. He is survived by his wife, a daughter and two stepsons.

John M. Dreisbach

► John M. Dreisbach, retired sales manager of the Scandinavia Belting Co., Newark, N. J., died on November 10 at the Overlook Hospital in Summit, N. J., after a brief illness. Mr. Dreisbach, who retired in 1949, was a graduate of Phillips Andover Academy and Yale University. He was a member of the South Orange-Maplewood Kiwanis Club, director of the New York-Newark Transmission Council and treasurer of the South Orange Community Orchestra. Surviving are his widow and two daughters.

James I. Simpson

► James Inglis Simpson, chairman of the board for Dunlop of Canada, Ltd., died recently in Toronto General Hospital following a short illness. He was 73 years old. Mr. Simpson went to Canada from Scotland in 1909, taking a position in the Royal Bank of Canada at Vancouver. Later, he became treasurer of the Dominion Trust Co. Following World War I service with the Irish Fusiliers of Vancouver, Mr. Simpson joined Canadian Industries, Ltd. In 1925, he was transferred to Toronto as Paint and Varnish Division manager and then to Montreal as general manager of fabrics and finishes. In 1932 Mr. Simpson was made general manager of Dunlop Tire and Rubber Goods Co., Ltd. He was elected president in 1939 and chairman of the board in 1953. Mr. Simpson was a former president of the Rubber Association of Canada. Surviving are his wife and a son.

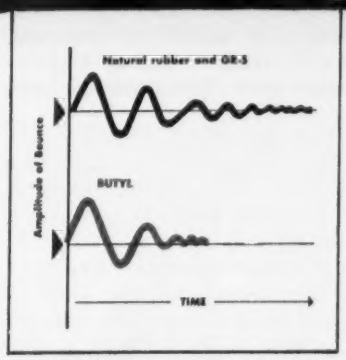
Odis O. Mosely

► Odis O. Mosely, factory manager of Pneus General, S. A., the Rio de Janeiro, Brazil, affiliate of the General Tire and Rubber Co., died on November 14 in Rio de Janeiro. He was 50 years old. A native of Milan, Tenn., Mr. Mosely attended the University of Akron. In 1933, he joined General Tire and served as a foreman in the Tire Division until his transfer to the overseas division in 1940. He went to Caracas, Venezuela in 1941 to help start a new plant for the company and stayed for five years as assistant factory manager. After a brief stay at General Tire's Mexico City plant, in 1946, Mr. Mosely was assigned to Porto, Portugal, where he was named factory manager two years later. He served there until his Rio de Janeiro appointment in 1956. Surviving are his wife and two daughters.

John A. Liljegren

► John A. Liljegren, retired technical director of Pioneer Rubber Mills, died August 29 at Pittsburg, Calif. He was 78 years old. He served the company for 34 years prior to his retirement in 1954. Mr. Liljegren was dean of rubber chemists in the Bay area and was respected and admired for both his technical and personal accomplishments. He was born in Moingona, Iowa and graduated from Drake University in Des Moines, Iowa. Prior to joining Pioneer, Mr. Liljegren was employed by the R. W. Hunt Co. of San Francisco. He was an honorary member of the Northern California Rubber Group, a member of the Rubber Division of the American Chemical Society, the Pittsburg Masonic Lodge No. 429, and past president of the Pittsburg Rotary Club. He is survived by his wife and a son.

BEST WAY TO ABSORB SHOCK!



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A constant volume of air at a controlled temperature in the heavily insulated cabinet, maintains uniform predetermined specimen temperatures regardless of variations in room conditions.

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From 21 to 126 samples, depending on size, can be simultaneously exposed to the light of the Atlas Enclosed Carbon Arc. Temperature is controlled automatically and humidity is furnished by evaporation from a constant water reservoir. Operation of the Fade-Ometer is completely automatic, permitting the machine to be left in continuous 24-hour operation.

The Carbon Arc Lamp in the Fade-Ometer produces radiation at the sample similar to sunlight, both as to intensity and spectral distribution.

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Overseas

Paris—Dispersions Plastiques, owned by the West German Badische Anilin Und Soda Fabrik and the French Kulhmann Compagnie Francaise des Materiels Colorantes Group, plans to start production of a polystyrene known as Styropar, which is said to have many industrial uses.

Bangkok—A bill to increase the Thai rubber tax to 50 satang from 25 satang to help improve the quality of Thai rubber is being prepared by the Thai department of Agriculture. A spokesman for the Department stated that though the demand for rubber is high, planters in Thailand still need government assistance to improve the quality of local rubber.

New Delhi—The Ministry of Industry in India plans to construct a new synthetic rubber plant at Bareilly, in the North Indian state of Uttar Pradesh. To be in production by 1961, the plant is expected to have a capacity of 20,000 to 30,000 tons annually.

Rome—In accordance with a recently signed contract, Italy will export 8,000 tons of synthetic rubber to the Soviet Union and import 800,000 tons of crude oil from that country.

Havana—B. F. Goodrich Chemical Co. has applied for a special tax exemption status in Cuba under that country's Law of Industrial Stimulation. Goodrich is reportedly negotiating for the construction of a new plastics plant near San Jose de la Lajas.

Tokyo—Nylon cord tires, said to be the first of their kind to be produced in Japan, are being made with domestically produced nylon '6' at the Hiratsuka plant of the Yokohama Rubber Co., Ltd., which is located near Tokyo. The plant is said to be capable of producing a monthly average of 500 to 600 tires.

Malaya—Plantation employers and workers have announced that they have reached an agreement on "certain points of principle" in their negotiations on a new wage pact. The groups planned a further meeting.

Paris—Construction has begun on a plastics and synthetic rubber plant at Villers-St. Sepulcre, which is located north of Paris, in accordance with an agreement between Ugine and the U. S. Rubber Co. Under the agreement, Ugine acquires exclusive licenses to manufacture a wide range of special rubbers, latex and plastic materials derived from butadiene, under U. S. Rubber patents. The plant is expected to go into production in January, 1960.

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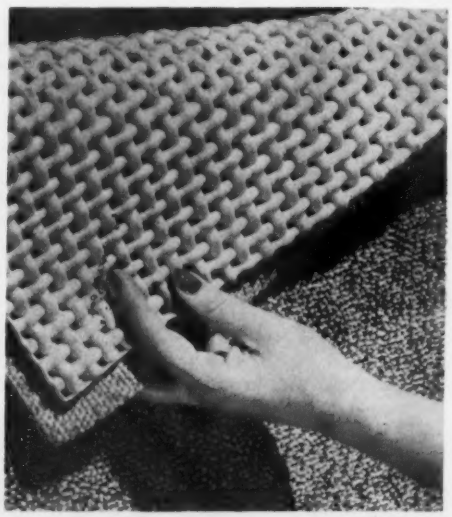
New Goods

Extralite Shoe Soling

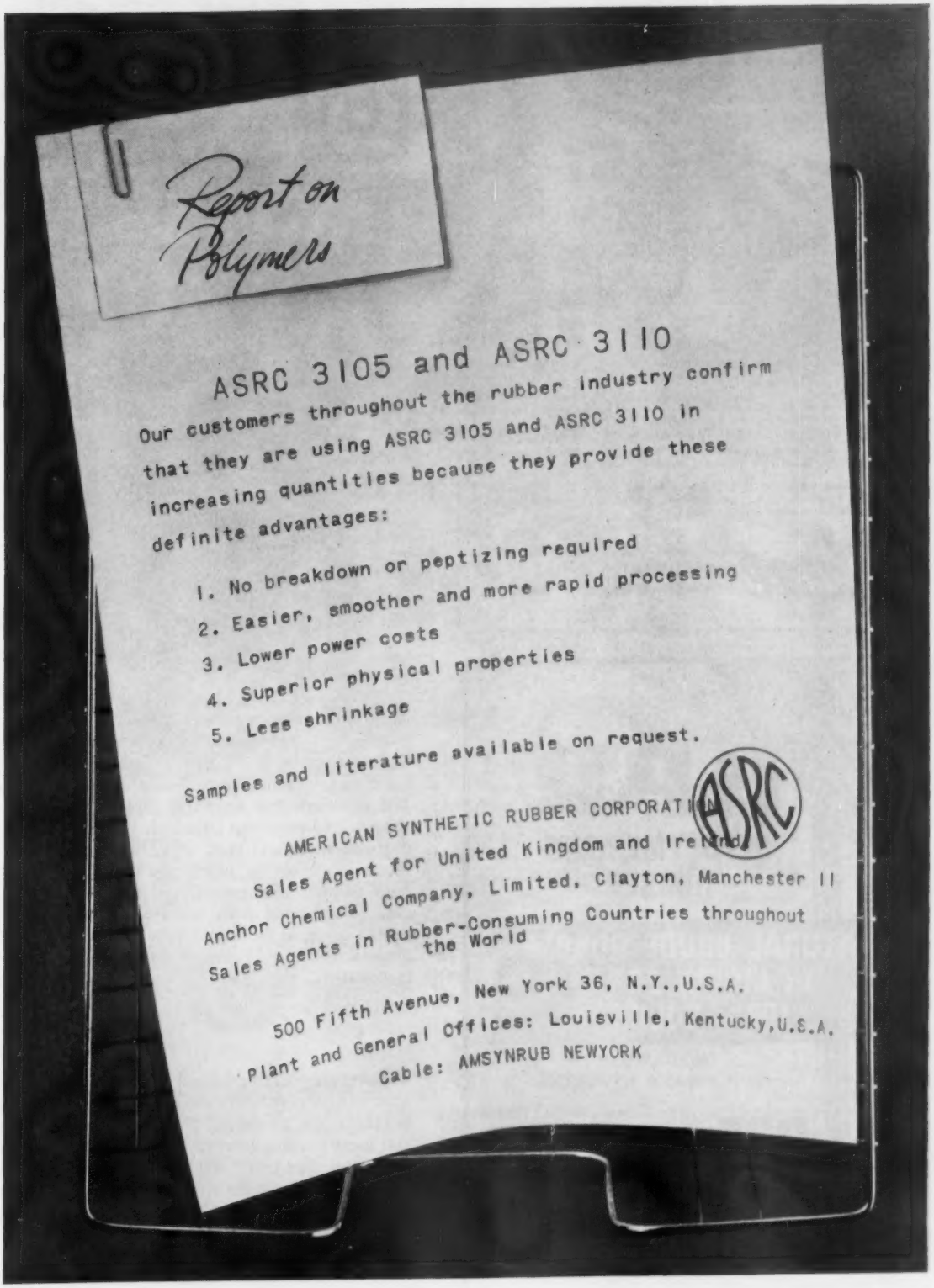
► B. F. Goodrich Industrial Products Co., Akron, Ohio, has developed what is said to be the first lightweight shoe soling that will outwear any other soling. Called "Extralite," the company believes that the new soling may also set new styling trends in footwear because it can be made in every color. Made in a combination of high-grade, synthetic rubbers, the soling material is said to be flexible and to have good abrasion, scuffing and cracking resistance. Comparative laboratory tests on the National Bureau of Standards abrasion index showed that the soling outwore most leathers by a considerable margin. The new soling is also waterproof, has high bond strength and a smooth cut edge that will eliminate edge finishing problems, the company claims. It is believed that manufacturers will find Extralite soling easier to work with than currently used materials.

Sponge Rubber Rug Underlay

► U.S. Rubber Co., 1230 Avenue of the Americas, New York, N. Y., is introducing a basketweave sponge rubber underlay, called "U.S. Marvelaire", to be sold through the company's branch sales organization, and "U.S. Regalaire"



carpet cushion, to be sold through the wholesale organization. Marvelaire and Regalaire are made of highly resilient sponge rubber in a distinctive basketweave that is designed to give more body, more luxurious feel underfoot, and added tensile strength, states the company.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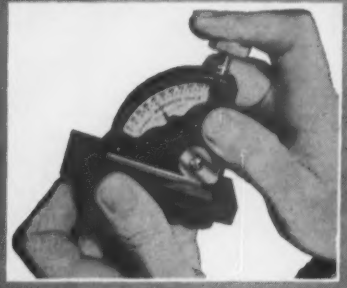

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Rubber-Fabric Container

► A new reinforced, molded rubber-fabric container has been introduced by Cauchotex Industries, 44 Whitehall St., New York, N. Y. Named the Fortex "Gar-Boy", Model BA25-40, this container can hold 10 gallons of most liquids, waste or other material. It is claimed to be resistant to lime, acids, salt water, grease and chemicals. The company states that Gar-Boy can be thoroughly cleaned and odor proofed and that the strongest acids, soaps or detergents will not harm its tough molded rubber-fabric composition. The container has no metal parts, no seams, no corners and no sharp edges. It is noiseless when dropped and won't dent, leak, break or mar surfaces. Said to be practically indestructible, it remains unharmed by extreme heat or cold. Gar-Boy is equipped with a handle and a molded rubber cover in pastel colors and has the over-all dimensions of 16½ inches top diameter and 19 inches high.

Flexsteel Sanitary Hose

► Goodyear Tire and Rubber Co., Akron, Ohio, is offering a new heavy duty sanitary hose for use in creameries, canneries, dairies, food preparation and meat packing plants. The new design, called "Flexsteel Sanitary," features a braid of high tensile steel wire and two cotton braids for rugged service. The cover is tan colored and highly resistant to animal and vegetable fats, oils, weather-aging and abrasion, the company states. Manufactured in 25 and 50 foot lengths with inside diameters from ½ to 1½ inches, the hose is built to withstand saturated steam pressures up to 100 pounds per square inch.

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Purchasing Agent's
peril
LOOK AT THESE FIGURES! PRODUCTION DOWN 7% THIS MONTH AND IT'S ALL YOUR FAULT!!
I KNOW, BOSS... SOLVENT CONTAMINATION AND LATE DELIVERY HAVE SLOWED THINGS DOWN BUT...
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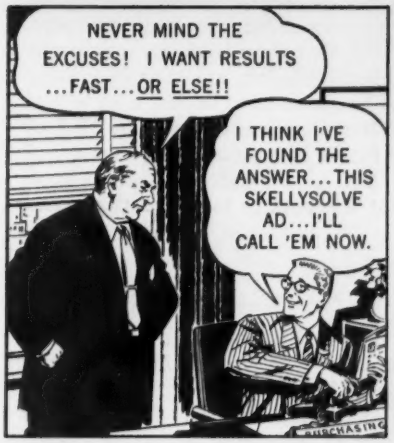

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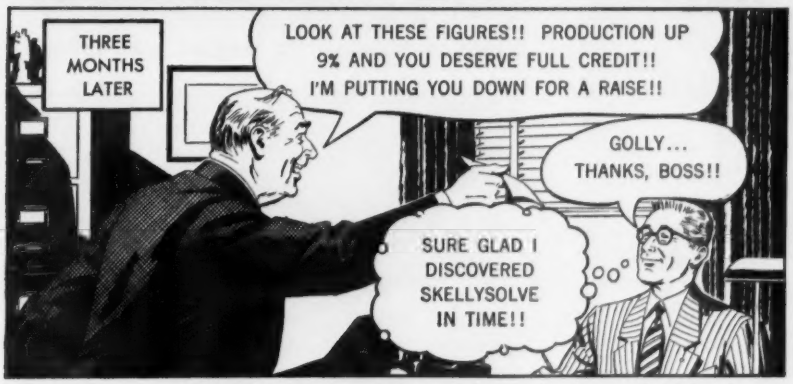
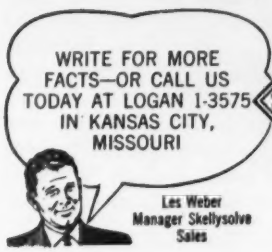
RIGHT! AND NINE OUT OF TEN CARS ARE SHIPPED THE DAY AFTER THE ORDER IS RECEIVED!!


THREE MONTHS LATER
LOOK AT THESE FIGURES!! PRODUCTION UP 9% AND YOU DESERVE FULL CREDIT!! I'M PUTTING YOU DOWN FOR A RAISE!!
GOLLY... THANKS, BOSS!!
SURE GLAD I DISCOVERED SKELLYSOLVE IN TIME!!

When solvents are so important to your business, why take chances on quality or delivery? Next time you order specify Skellysolve.



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STANDARD THROAT 1¾" MODEL

THROAT DEPTHS
1¾" to 26"
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Table and Roll or two Rolls
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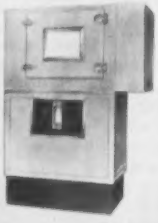

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Accommodates MDC Dynamat (Rubber Stretching Apparatus)

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Vinyl Coated Aluminum Siding

► A new type of house siding made of vinyl coated aluminum has been developed by Hastings Aluminum Products, Inc., Hastings, Mich. The new siding is said to retain its durable finish and attractive appearance through rigorous weather for years without requiring repainting. The aluminum siding is coated with a special formulation made with Geon vinyl resin supplied by B. F. Goodrich Co. Both sides of the aluminum are coated before the siding is fabricated. The metal then can be formed, bent, punched and even applied to the house without affecting either the appearance or performance of the finish, the company reports. The enamel-like coating, called "Superclad", is by Sherwin-Williams Inc., and produces not only outstanding appearance but also a wear and weather resistance far beyond finishes heretofore available, the company states. Durability is such that the manufacturer warrants the finish against blistering, cracking or crazing for 10 years. Available in white and a variety of pastel colors, the siding panels come in 10 foot lengths with a full ⅛ inch exposure for economical applications. The panels lock together to form a weather tight V-groove so there are no exposed nail heads.

Goodyear Life Raft

► Goodyear Tire and Rubber Co., Akron, Ohio, has introduced a 25-man life raft, for commercial jet aircraft slated for overseas flights, that is said to inflate in only nine seconds. The manually actuated raft, sold under the trademark "Raft-Air," is made of two-ply rubberized nylon designed to withstand the roughest seas. Inflatair

devices, produced by Walter Kidde & Co., Belleville, N. J., are used to inflate the rafts. Each RaftAir is equipped with complete accessory and emergency equipment for survival at sea including fishing equipment, flares, first aid devices, signaling mirrors, dye markers, a flashlight, a knife, a sea anchor and rations including fresh water. The rafts are packed in a protective, self-opening coated nylon envelope which is light in weight and compact for easy handling, according to Goodyear.

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SAG 470 Silicone Antifoam Emulsion is a NEW and extremely effective antifoam liquid designed specifically for quenching foam in aqueous systems. It is very stable, possesses low viscosity, is inexpensive to use and easy to handle. For quenching, preventing, or controlling foam, SAG 470 will eliminate waste, reduce process time and permit fuller use of productive capacity. Manufactured by: Union Carbide Corporation, Silicones Division. Sold by The C. P. Hall Co.

NEW RUBBER MOLD RELEASE AGENT SAVES 10%

A new high viscosity silicone oil emulsion called LE-46 has recently been introduced by The C. P. Hall Co. Tire manufacturers and retreaders report up to 10% saving over conventional rubber mold release agents. LE-46 provides a more substantial, stable and durable film at mold temperatures, lends itself to automatic spray equipment because it "flats out" extremely well. Manufactured by: Union Carbide Corporation, Silicones Division. Sold by The C. P. Hall Co.

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Investigate Johnson Joints for all steam-heated or water-cooled rolls. Handle Dowtherm, Monsanto Aroclors, hot oils too. Sizes to 8". For data on Type SN write for Bulletin N-2002.

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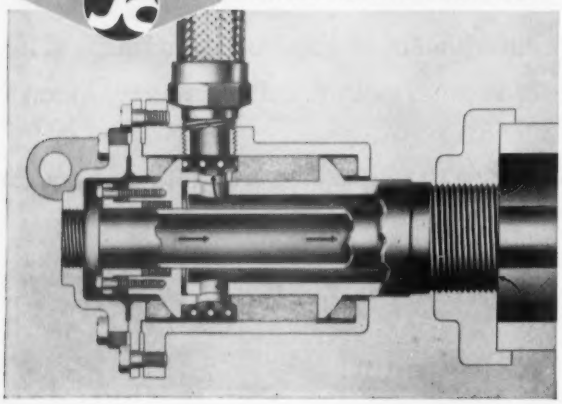

New Equipment

LECO Gasometric Carbon Analyzers

► LECO Gasometric Carbon Analyzers, manufactured by Laboratory Equipment Corp., St. Joseph, Mich., are said to make a determination of the amount of carbon in a rubber sample in 20 minutes. The principle of operation involves burning the sample, and measuring the gas produced to determine the per cent of carbon dioxide present. Operation is said to be extremely simple, and analysis accuracy generally to be within 1% of the carbon present. The analyzers come in two main types, Standard Hand Operated and Semi-Automatic, of which four models are available. Bases of the units are 12 x 14 inches, and height for all except one model is 37 inches. Outstanding advantage of the instruments is the speed of the analysis.

Electric Strip Heaters

► Chromalox electric strip heaters, manufactured by Edwin L. Wiegand Co., 7500 Thomas Blvd., Pittsburgh 8, Penna., are used for four general purposes: (1) to keep viscous and heavy compounds moving smoothly; (2) for ovens and special-purpose air heating; (3) for tanks, kettles, drums and similar units, and (4) for new or converted platens and other production equipment. Available in a range of sizes, the heaters can be applied to a variety of machines used with rubber, as for example, the platens of a press for splicing synthetics if the load is so small that use of steam is unwieldy.

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COMPENSATOR DANCERS

DESIGNED FOR ANY FABRIC TENSION RANGE
MAXIMUM ROLL DEFLECTION OF .010"
SIMPLE, RUGGED CONSTRUCTION

COUNTERBALANCED BY WEIGHT, AIR OR HYDRAULIC
SYMMETRICALLY LOADED TO PREVENT TWISTING
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SINGLE OR MULTIPLE ROLL TO PROVIDE
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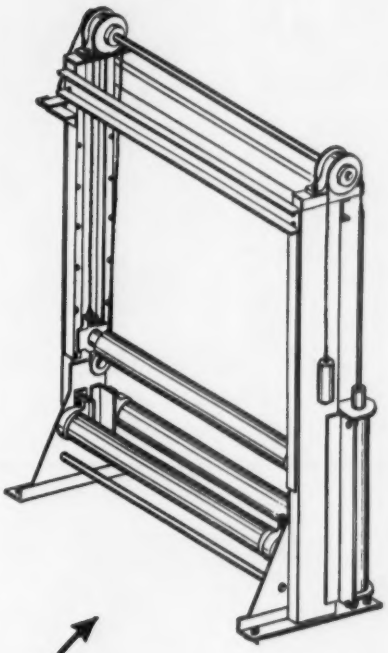

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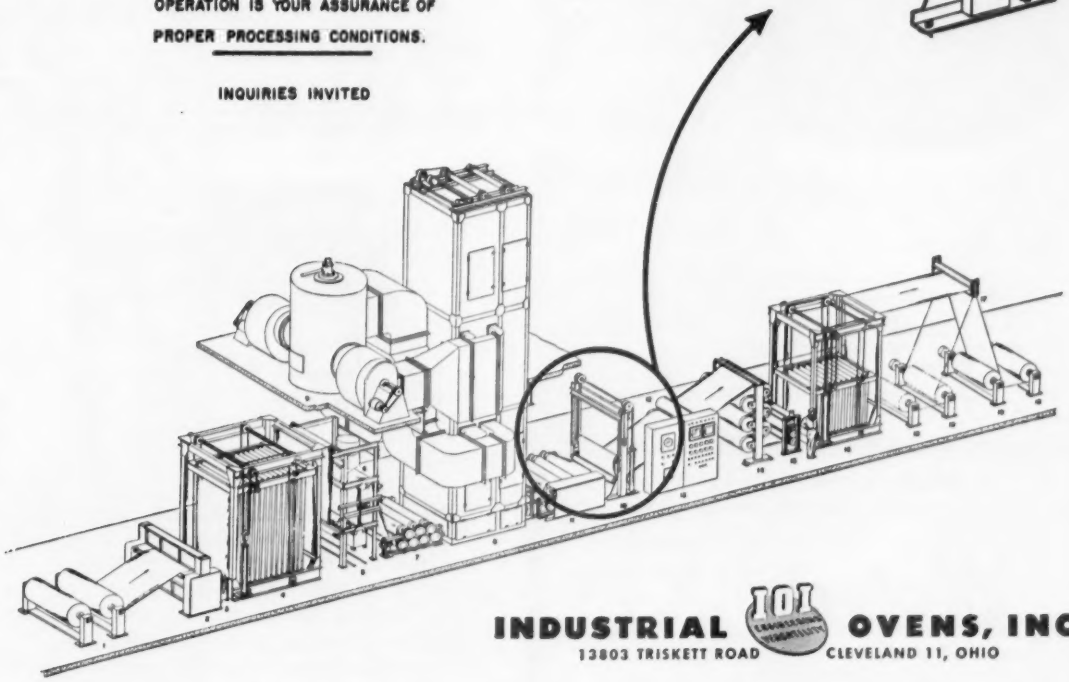

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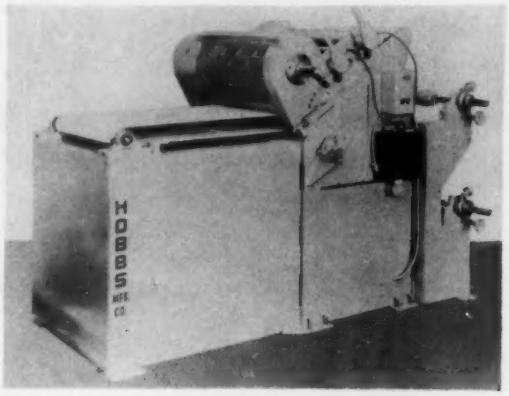
Hobbs Rotary Cutter

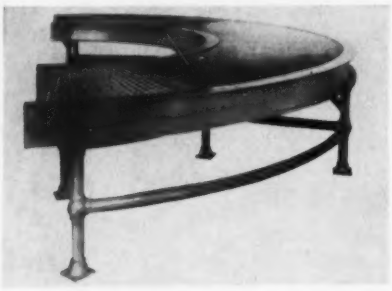
► A new rotary cutter designed to cut from rolls or in synchronization with in-process work has been announced by Hobbs Manufacturing Co.,



Worcester, Mass. Available in widths from 24 to 60 inches, the machine cuts pieces which are from 2 to 60 inches long. It is said to provide infinitely variable cutoff lengths, at speeds up to 50 cuts per minute. The cutter can be supplied with or without a slitting device for longitudinal cutting. Accessory equipment also includes unwinding stands, run-out conveyors and stockers.

Taperweave Curve Conveyor

► The addition of the Taperweave Curve Conveyor to its standard line of woven metal mesh conveyors has been announced by Wiretyer Corp., 65 Leliarts Lane, East Paterson, N. J. Differing



from conventional curved metal mesh belt conveyors in which the belt must flex around an arc, this unit employs a wire mesh belt which is woven to a taper corresponding to the inner and outer radii of the curve. This is said to permit a flat, level conveying surface and minimize wear of expensive metal belts. The unit is capable of moving loads up to 2,000 pounds at speeds up to 200 feet per minute.

U. S. Shor-Kwik inflatable dunnage by U. S. Rubber Co. uses Wellington Sears nylon fabric.

Fabric helps protect cargo with cushions of air

Unoccupied box-car space can cause costly damage to goods in transit. This space must be controlled by "dunnage," usually consisting of elaborate blocking, bracing and strapping, to keep cargo from shifting or breaking loose.

These days, rigid bracing is being replaced more and more by new *inflatable* dunnage. Bags made of a neoprene-coated nylon fabric, enclosing a butyl rubber air chamber, are placed in position and inflated. They hold cargo firmly yet resiliently. This method is fast and cheap. Inflatable dunnage reduces cargo handling costs, cuts down damage claims considerably. It deflates easily for return shipment.

Once again, as in so many of the recent new developments in rubber and plastics, Wellington Sears provides the fabric. It is another important example of how this company continues to add to its record of textile service to industry for more than a century. This experience is yours to call on for help in solving your fabric problems. For free copy of "Fabrics Plus," write Department G-1.

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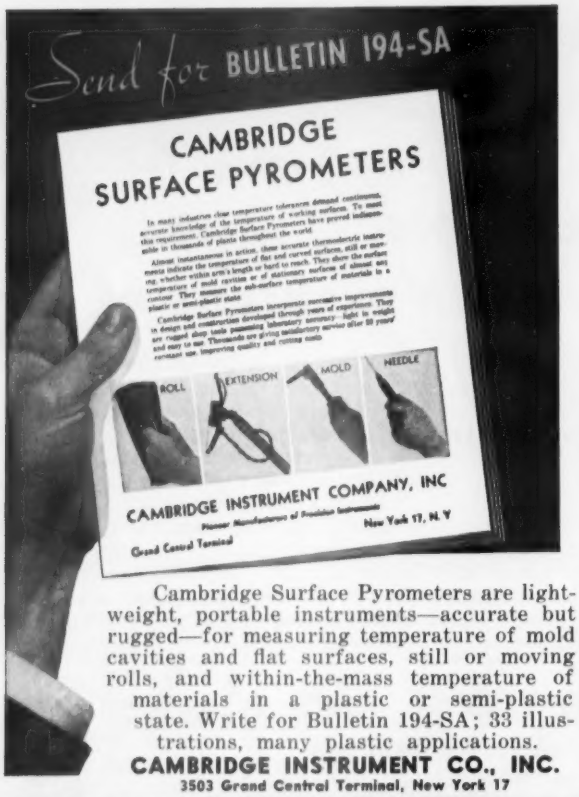


Cambridge Surface Pyrometers are lightweight, portable instruments—accurate but rugged—for measuring temperature of mold cavities and flat surfaces, still or moving rolls, and within-the-mass temperature of materials in a plastic or semi-plastic state. Write for Bulletin 194-SA; 33 illustrations, many plastic applications.

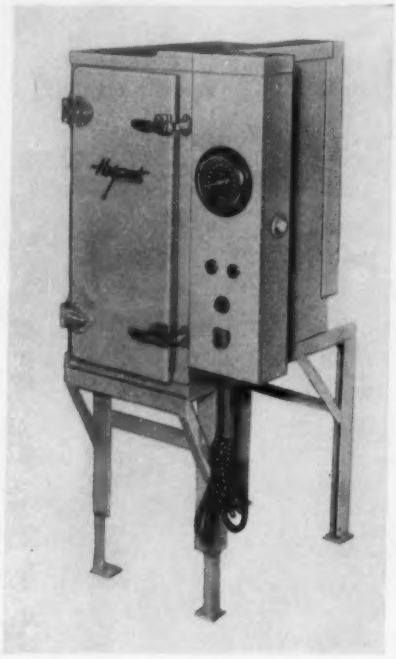
CAMBRIDGE INSTRUMENT CO., INC.

3503 Grand Central Terminal, New York 17

THEY HELP SAVE MONEY AND MAKE BETTER RUBBER

Constant Temperature Test Cabinet

► Electric Hotpack Co., Inc., 5060 Cottman St., Philadelphia 35, Penna., has developed a mechanically convected constant temperature test cabinet designed for use on a table model Instron tensile strength tester. It features a temperature range



from room temperature to 600°F., ± 1°C. control. The interior of the oven is 8½ x 10 x 22⅞ inches; the exterior is 14½ x 32 x 29⅛ inches. The heaters are approximately 1600 watts on 110 or 220 volts AC. Openings are provided in the oven for the mounting of test equipment at the ceiling and floor. The controls are in a control panel on the side of the oven; they consist of a 3-heat switch, thermostat, limitstat with reset button and pilot lights. An indicating dial type thermometer is recessed into the panel. Air is circulated through the cabinet by a specially designed blower and motor, which are located in the rear of the oven.

► A simple method of measuring temperatures of various materials and surfaces is provided by using the Model B **portable hand pyrometer** manufactured by West Instrument Corp., 4363 West Montrose Ave., Chicago, Ill. The instrument requires no power source, special tools or operator skill, and may be used for measuring temperatures of convex, rotating as well as flat surfaces

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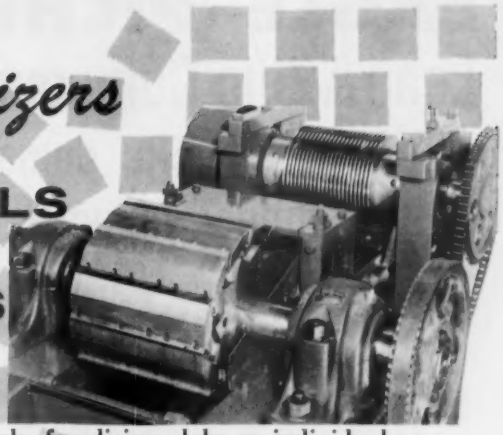

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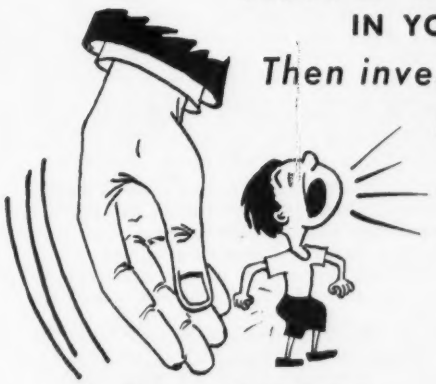

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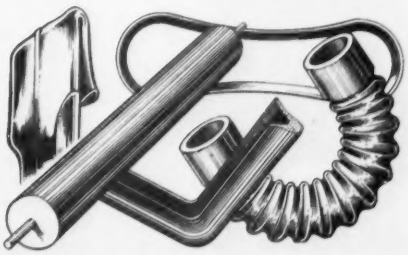

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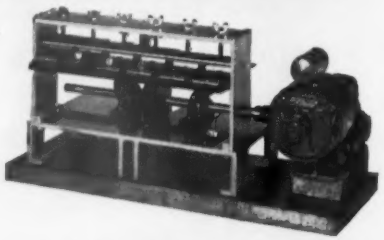
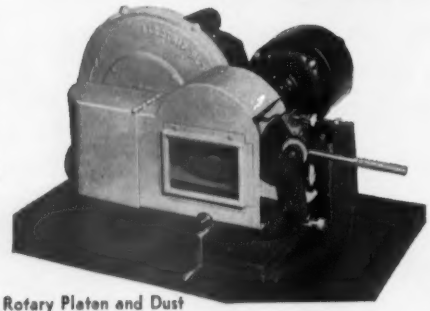
ROSS RUBBER FLEXING MACHINE
(for ASTM D1052)



RUBBER SAMPLE BUFFING MACHINE



(Shown with Rotary Platen and Dust Collector with Suction Blower.)

EMERSON APPARATUS CO.
183 Tremont St., Melrose, Mass.

Reviews

The Rheology of Elastomers. Edited by P. Mason and N. Wookey. Published by Pergamon Press, Inc., 122 East 55th Street, New York 22, N. Y. 5¾ x 9 in. 202 pp. $8.50.

This book includes the contributed papers and discussions of a conference on "Rheology of Elastomers" organized by the British Society of Rheology and held in England in May, 1957. It is a collection of specialist articles giving the most advanced theories on various aspects of the deformation and flow of elastomers. A listing of the papers presented at the conference will indicate its scope and character:

"The Present Status of the Theory of Large Elastic Deformations," "Thermodynamics of Rubber in Extension: A Study of the Relation between Tension and Temperature at Equilibrium—Part I: Reversibility and Method of Analysis," "The Photo-elastic Properties of Rubberlike Polymers," "A Note on the Elasticity of Gelatin Gels," "An Experimental Study of Stress Relaxation and Viscous Flow in Natural Rubber," "Network Theories of Stress Relaxation and Set in Rubber," "A Theory of Elastic Recovery in Concentrated Solutions of Elastomers," "Temperature-Frequency Relationships of Dielectric and Mechanical Properties of Polymers," "The Tearing of Rubber," "Mechanical Properties of Irradiated Filled Rubber," "Dynamic Viscoelasticity of Polyester Cured by Irradiation," "The Recovery Behavior of Polyethylene at Large Strains," "Elastic Effects in the Extrusion of Polythene," "High-Temperature Tensometry and its Application to Amorphous Polyethylene Terephthalate."

The discussions which followed the presentation of the papers are printed in full. The book was carefully prepared, and the illustrations and graphs legible and easily interpreted. A stimulating volume for those interested in theory.

•

Vinyl Resins. By W. Mayo Smith. Published by Reinhold Publishing Corp., 430 Park Ave., New York 22, N. Y. 5¼ x 7¾ in. 282 pp. $5.75.

This book is part of a series of short volumes on the various plastics materials, their applications and fabrication processes. The book is semi-technical—one does not have to be a chemist to understand it, and indeed its major appeal will probably be to those non-technical people who have need of a comprehensive knowledge of vinyl resins.

There are six chapters: (1) Scope of the Vinyls, (2) Types and Properties, (3) Chemistry, (4) Manufacture and Fabrication, (5) Applications, (6) New Developments. In these chapters are presented a great deal of data on consumption, production techniques, and especially on applications and end uses.

The vinyl resins, of course, have a direct relation to the rubber industry. One estimate of PVC foam production in 1960 predicts that 75 million pounds will be produced, mostly flexible. And purchase of PVC by the wire and cable industry for coating has been estimated at 150 to 175 million pounds for the same year.

This book fills a need for a source of information on vinyl resins which is exact and up-to-date, comprehensive, with extensive technical data on manufacture and properties of the end product. A good balance between technical and semi-technical coverage has been achieved. The presentation is excellent, and the illustrations are of high quality and attractively displayed.

Raw Materials: A Study of American Policy. By Percy W. Bidwell. Published by the Council on Foreign Relations, 58 East 68th St., New York 21, N. Y. 5¾ x 8¾ in. 404 pp. $5.95.

The purposes of this book are to examine the more important measures of United States foreign policy which affect the supply of materials for American industries and to suggest changes in national policies which will make them better adapted to the technological advances and changes in international relations which may be expected in the near future. The first chapter discusses the objectives of national policy. Chapters 2 and 3 describe the principal legislative and executive measures affecting industrial materials, with particular attention to developments since the end of World War II. A series of case studies pertaining to specific raw materials are analyzed in the next chapters, and the last, Chapter 10, summarizes the accomplishments and failures of national policy and suggests measures of reform.

Chapter 9 discusses national policy on rubber. The chapter is a short history of the rubber industry since Pearl Harbor and a cross-sectional analysis of the field today. The loss of the natural supply in 1941 brought about by the war and the launching of the emergency synthetic rubber program are discussed. This is followed by a description of the transition to private ownership. The author continues with an extended analysis of the economics of the industry (supply and demand, price, the competition of synthetic with natural rubber, etc.). Reclaimed rubber as a source of supply and its place in the total picture, and the sources of supply of natural rubber and the factors which influence its production and market, are also analyzed.

The chapter closes with consideration of the present outlook for the industry (which the author considers optimistic), and with a discussion of problems of national policy—particularly, the rubber embargo and the stockpiling policy. Pros and cons of these basic practices are detailed.

This book makes interesting reading. For people in the rubber industry, the chapter on our basic raw materials is filled with facts and figures, charts and graphs. Most of what the author has to say is not new, but it is of value in its presentation. His scholarly discussion of the interrelationship of current production and demand with prices and present national policies, each factor analyzed with the others in mind, is well worth perusal. The writer has done a commendable job in presenting a clear analysis of national policy on raw materials in general and for specific industries in particular. This book is recommended reading.

•

Handbook of Chemistry and Physics: 40th Edition. Edited by Charles D. Hodgman. Published by the Chemical Rubber Publishing Co., 2310 Superior Ave. N.E., Cleveland 14, Ohio. 5 x 7½ in. 3456 pp. $12.00.

Like its predecessors, the latest edition of this standard work is divided into five basic indexed sections: Mathematical Tables, Properties and Physical Constants, General Chemical Tables, Heat and Hygrometry, and Quantities and Units. More than 100 pages of new and revised scientific facts have been added, with important new information included on such subjects as the thermodynamic properties of both the elements and the oxides, chelating agents, ion exchange resins, superconducting transition temperatures, and the physical constants of inorganic hydrides. Over 200 authorities have collaborated in preparing this new volume which maintains its continuing reputation for comprehensive presentation of factual data with accuracy and clarity.

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BOOKLETS, CATALOGS, etc.

Flectol H Antioxidant for Rubber. (Technical Service Bulletin No. 12A/1). Monsanto Chemicals Limited, Monsanto House, 10-18 Victoria St., London, S.W.1, England. 8 x 10 in. 20 pp.

The results of a study of Flectol H, a general purpose antioxidant, in various polymers are offered in this bulletin. Physical and chemical characteristics of the material are detailed. Data are given on tests (aging, weathering, flexing, staining, etc.) performed to determine effects of the antioxidant in natural rubber black stocks and white stocks, styrene rubber, nitrile rubber and chloroprene rubber. Graphs and tables are used to give this information in a simplified form. An appendix of information on mixing, curing, and test methods closes the booklet.

•

RC Plasticizers and Comonomers. Rubber Corporation of America, Hicksville, N. Y. 8¼ x 10¾ in. 44 pp.

Extensive information on twenty-six rubber plasticizers and seven comonomers (used for varying resin properties by copolymerizing a basic monomer with modifying comonomers) manufactured by Rubber Corp. of America is given in this bulletin. A description of each is presented, and formulas, specification and other typical properties detailed. Nine pages are devoted to performance data, applications recommendations (including a listing of recommended plasticizers and comonomers for use in specific polymers or specific end products), and a description of test methods.

•

Jordan Controls. (Bulletin No. J-101). Jordan Co., Inc., 3235 West Hampton Ave., Milwaukee 9, Wisc. 8½ x 11 in. 8 pp.

This bulletin offers new information on Jordan Shaftrol and Valvetrol shaft-mounted positioning gearmotors for valves, drives, pumps and other applications. Specifications on a new Digital control system for machine tool positioning and for process control are also presented. Each of the items is described in detail, and data of dimensions supplied in tabular form. Photographs and schematic diagrams are used to good advantage. Special features and their advantages are also analyzed.

•

Carbon Black in Rubber. (Application Sheet No. 118). Laboratory Equipment Corp., St. Joseph, Mich. 8½ x 11 in. 2 pp.

This application sheet describes a method for determining the quantity of carbon black in rubber which requires ¾-hour to perform. The method involves use of a Leco induction heater to volatize all organic material in a sample without carbonization, and determination of the carbon by direct analysis. Included in the description of the process is a table comparing results obtained with the new method and those obtained with a standard 3-hour method in current use.

•

Johnson Horizontal Steam Generator. (Bulletin No. 8-C). Mears-Kane-Ofeldt, Inc., Church Road, Bridgeport 36, Penna. 8½ x 11 in. 4 pp.

A horizontal steam boiler which is available in 6½, 15, 25 and 33 hp sizes for use with gas, oil or combination gas and oil is described in this bulletin. General specifications (dimensions, valve sizes, combustion space, etc.) are given for each in tabular form, and a schematic diagram is used to show the operation of the unit. Information on design, working pressures, auxiliary equipment and related subjects is presented in text form.

Monsanto Chemicals for the Footwear Industry. (Technical Service Bulletin No. 13A/1). Monsanto Chemicals Limited, Monsanto House, 10-18 Victoria St., London, S.W.1, England. 8 x 10 in. 12 pp.

This booklet gives formulations for various rubber components used in the footwear manufacturing industry, together with brief details of methods of manufacture. Among compounds considered are those for the following kinds of soles: brown and black, stick-on, translucent, resin rubber, semi-expanded, microcellular, and directly vulcanized. Compounds are also given for rubber boots and for canvas shoe and slipper soles. The functions in these compounds of accelerators and antioxidants, as well as specially designed rubber reinforcing copolymers, TRED 50 and TRED 85, manufactured by Monsanto, are explained.

•

Beckman/Spinco Preparative Ultracentrifuge Model L. (Bulletin SBL-2). Spinco Division, Beckman Instruments, Inc., Stanford Industrial Park, Palo Alto, Calif. 8½ x 11 in. 12 pp.

This new brochure gives information on the Spinco Model L preparative ultracentrifuge. Data are given on applications, field services available, features and operating characteristics of the standard unit. Applications include clarifying colloidal materials for measurement by light scattering and preparing solutions for electron microscopy. Details are given on the nine available fixed angle, batch and swinging-bucket rotors, with tabulated specifications on all. Rotor accessories and special tubes and adapters are also covered. A list of literature references closes the booklet.

•

Hyde Handbook of Industrial Knives. Hyde Manufacturing Co., Southbridge, Mass. 3¼ x 6¼ in. 52 pp.

This pocketsize handbook illustrates a thousand industrial hand and machine knives and other tools. The opening pages are devoted to plant facilities, production techniques and related subjects. Six pages of the booklet are used for rubber tools. Sixteen circular knives are shown with an indication of size and function. Illustrations and similar data are given for 46 hand knives and 34 miscellaneous knives. A well designed and interesting brochure.

•

Alnor Pyrotac. (Bulletin No. 2002). Illinois Testing Laboratories, Inc., 420 North LaSalle St., Chicago 10, Ill. 8½ x 11 in. 8 pp.

An instrument which acts as an excess temperature protective device by sounding an alarm and/or shutting down an operation when the safe maximum temperature is reached is described in this bulletin. Complete specifications, schematic application wiring diagrams, and an explanation of the principle of operation are provided. A table provides data on the ranges available, which go from 0° to 400°F. up to 0° to 3000°F. Electrical specifications and ordering instructions are also included.

•

Process Equipment and Systems. (Bulletin No. 200). Sprout, Waldron & Co., Inc., 130 Logan St., Muncy, Penna. 8½ x 11 in. 8 pp.

This condensed catalogue covers equipment for size reduction, size classification, mixing and blending, materials handling, pelleting and densifying, pulp refining and digesting. Size ranges, connected horsepower, design construction highlights and general applications for each type of equipment are included. Each item is accompanied by descriptive text and an illustration. Many of the machines are used in the processing of rubber.

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DR. JEAN LE BRAS
French Rubber Institute

translated by
IRENE E. BERCK, Ph.D.
Editor, Chemical Publishing Co., Inc.

460 pages • illustrated • 1957 • $12.00

This is the first book ever published which thoroughly covers the entire rubber industry, including synthetic elastomers, latices of both natural and synthetic rubbers, and even the pertinent plastics, in less than 500 pages.

It is written especially for the busy rubber chemist and technologist, beginner and student, who have no time to untangle the details they really need from a maze of compiled literature.

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MARKET REPORTS

TRENDS
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Natural Rubber

Since our last report (December 1), the price of natural rubber on the New York Commodity Exchange has moved in a range of 125 points, high for the period being 31.13c reached on December 1, and low being 29.88c reached on December 12 and 19. The average price of spot rubber for the month of December was 30.28c based on 21 trading days. This compares with an average of 32.10c in the previous month.

Market Steadying

Analysts at Merrill Lynch, Pierce, Fenner & Smith note that the price decline was brought about by the closing off of Malayan purchases by Red China and Russia stepping out of the Singapore market. This situation was an effective price depressant and was reflected in Malayan shipments which were 63,408 tons to China in the first nine months of 1958, double the figure for all of 1957, and nil since.

Increased support by Western consuming countries has slowed the price retreat, and in view of the widespread optimism concerning U. S. rubber consumption for 1959, there is the feeling that the price structure for rubber will be sustained and even improved in the near future.

Communist Bloc

The unpredictability of Russian and Chinese buying is likely to be more of an enigma in 1959. Their purchases continue to grow but with considerable irregularity. In 1958, the Soviet bloc alone took 20 per cent more crude than in 1957. The estimated figure of about 350,000 tons represents close to 20 per cent of world output.

The purchases by this bloc were the prime stimulus to the summer price uptrend, and the bloc was also the major factor behind the price retreat. The bloc knows it holds substantial power over prices and its operations in 1959 could turn an expected world deficit of natural into a surplus and enlarge that deficit.

We can assume that the imports of natural by all Communist countries might increase in 1959 by 10 per cent, keeping in mind that a 10 per cent alteration in total buying could have as much effect on crude prices as an adjustment of two million cars more or less from the current 5½ million estimate of domestic auto production.

Unless purchases of natural by the Communist countries are reduced in 1959, a reasonable indication is that another deficit will be recorded, not a very large one, but bigger than those of 1956 and 1958.

NEW YORK, JANUARY 2, 1959

Price Data

Closing Rubber Prices on New York Commodity Exchange

FROM DEC. 1 TO DEC. 31

Dec.	Spot	Jan.	Mar.	May	Sales
1	31.13	30.68	30.45	30.15	33
2	30.63	30.10	29.85	29.60	82
3	30.75	30.30	29.90	29.80	58
4	30.25	29.75	29.55	29.45	56
5	30.50	30.05	29.80	29.60	32
6	....	....	....	....	...
7	....	....	....	....	...
8	30.50	30.30	30.10	29.87	30
9	30.25	29.85	29.70	29.45	28
10	30.25	29.95	29.79	29.56	51
11	30.00	29.60	29.46	29.19	21
12	29.88	29.55	29.22	29.05	54
13	....	....	....	....	...
14	....	....	....	....	...
15	30.00	29.82	29.44	29.20	31
16	30.13	29.90	29.60	29.35	39
17	30.13	30.10	29.80	29.62	35
18	30.13	30.00	29.65	29.55	17
19	29.88	29.90	29.80	29.55	33
20	....	....	....	....	...
21	....	....	....	....	...
22	30.25	30.20	30.06	29.75	18
23	30.38	30.20	30.12	29.85	6
24	30.25	30.15	30.12	29.80	9
25	....	....	....	....	...
26	....	....	....	....	...
27	....	....	....	....	...
28	....	....	....	....	...
29	30.13	30.02	29.90	29.72	1
30	30.25	30.05	30.00	29.82	30
31	30.25	30.15	30.10	29.85	13

Outside Market

No. 1 Ribbed Smoked Sheets:	
Spot	.30¼
Feb.	.30⅛
Mar.	.30
Thin Latex Crepe:	
Spot	.32¾
Thin Brown Crepe, No. 2	.27½
Flat Bark Crepe	.21½

London Market
(Standard Smoked Sheets)

March	28.91 — 29.06
Apr.-June	29.20 — 29.35

Singapore Market
(Standard Smoked Sheets)

Feb.	27.90 — 27.94

Middling Upland Quotations

	Dec. 1	January 2		
	Close	High	Low	Close
Mar.	35.33	34.72	34.57	34.70
May	35.44	34.84	34.70	34.84
July	33.88	33.84	33.73	33.81

Notes & Quotes

According to Harvey S. Firestone, Jr., chairman of the board of the Firestone Tire & Rubber Co., 1959 should be the best sales year in the history of the rubber industry. He bases his forecast on the continuing growth of unit tire sales, increased sales of all other divisions in the rubber industry and the encouraging rate of expansion of foreign operations.

Synthetic Rubber

According to the Natural Rubber Bureau, world synthetic rubber production and consumption in 1959 will increase 15 per cent over 1958 figures. The projected figures do not include estimated production and consumption of synthetic rubber by the Soviet Union and Red China.

Estimated world production of synthetic rubber for 1959 has been set at 1,485,000 long tons as compared with the 1,260,000 long tons produced in 1958.

It is expected that the United States will produce 1,185,000 long tons of synthetic rubber in 1959 with the rest of the Free World turning out 300,000 long tons. It is further estimated by NRB that the Free World will consume some 480,000 long tons of synthetic rubber this year.

Production-Consumption Gap

The 180,000 long ton gap between European production and consumption will obviously have to be filled by imports, presumably from the United States and Canada. It must be noted, however, that the Soviet Union has been making aggressive gestures toward the European synthetic rubber market. U. S. and Canadian producers may conceivably find themselves competing with large-scale, low-cost Russian synthetic.

Last year, the United States produced something over a million long tons of synthetic rubber. Of this sum the U. S. consumed 870,000 long tons. Of the estimated 1,185,000 long tons the U. S. is expected to produce this year, NRB estimates it will consume 955,000 long tons, leaving 230,000 long tons available for export.

During 1958, about 180,000 long tons of synthetic rubber capacity were completed abroad. By 1962, it is estimated that synthetic rubber capacity outside the U. S. (exclusive of Russia and China) will total 700,000 long tons.

Canada, presently the leading producer outside of the U. S., with a capacity to produce 135,000 long tons today, will increase that capacity to 180,000 long tons by 1962. By 1962, West Germany, the United Kingdom and Ireland will have the capacity to produce 260.000 long tons. Today, these nations have the ability to produce 160,000 long tons.

Outside Europe, the rest of the Free World will also be active in synthetic by 1962. India, Australia and Japan have plans afoot for the production of 95,000 long tons of synthetic rubber a year by that time.

CYDAC*

(N-cyclohexyl benzothiazole-2-sulfenamide)

Accelerator

Note[1] that **CYDAC**
flows freely, won't bridge, isn't dusty

Discover[2] that **CYDAC**
disperses quickly, is ideal in automatic equipment, offers many handling-ease economies, substitutes directly for powdered forms, cures the same, costs no more!

CYANAMID

AMERICAN CYANAMID COMPANY
Rubber Chemicals Department
Bound Brook, New Jersey

*Trademark

[1] CYDAC FLAKED, the only commercial flaked form of the popular N-cyclohexyl benzothiazole-2-sulfenamide is photographed here in actual size.

[2] A phone call, wire or letter to Cyanamid will bring you samples and technical information.

PRICES OF COMMERCIALLY AVAILABLE SYNTHETIC RUBBER

Dry Rubber

(per pound carload)

Butadiene-Acrylonitrile Types

Butaprene NF	.4900 [1]
Butaprene NH	.6500 [1]
Butaprene NL	.5000 [1]
Butaprene NXM	.5800 [1]
Chemigum N1NS	.6400 [2]
Chemigum N3NS	.5800 [2]
Chemigum N5	.5800 [2]
Chemigum N6	.5000 [2]
Chemigum N6B	.5000 [2]
Chemigum N7	.5000 [2]
Chemigum N8	.5000 [2]
Chemigum N600	.5000 [2]
Hercol N-33	.6800 [2]
Hycar 1001	.5800 [2]
Hycar 1002	.5000 [2]
Hycar 1014	.6000 [2]
Hycar 1041	.5800 [2]
Hycar 1042 and 1043	.5000 [2]
Hycar 1312	.5000 [2]
Hycar 1411	.6200 [2]
Hycar 1432	.5900 [2]
Hycar 1441	.6200 [2]
Paracril AJ	.4850 [2]
Paracril ALT	.5000 [2]
Paracril B and BJ	.5000 [2]
Paracril BLT and BJLT	.5000 [2]
Paracril C and CLT	.5800 [2]
Paracril CV	.5900 [2]
Paracril D	.6500 [2]
Paracril 18-80	.6000 [2]
Paracril OZO	.4600 [2]
Polysar Krynac 800	.5000 [2]
Polysar Krynac 801	.5800 [2]
Polysar Krynac 802	.5000 [2]
Polysar Krynac 803	.5000 [2]

Butadiene-Styrene Types

Ameripol 1000	.2410 [2]
Ameripol 1001	.2410 [2]
Ameripol 1002	.2435 [2]
Ameripol 1006	.2410 [2]
Ameripol 1006 (crumb)	.2475 [2]
Ameripol 1007	.2410 [2]
Ameripol 1009	.2590 [2]
Ameripol 1011	.2475 [2]
Ameripol 1012	.2425 [2]
Ameripol 1012 (crumb)	.2490 [2]
Ameripol 1013	.2500 [2]
Ameripol 1013 (crumb)	.2615 [2]
Ameripol 1500	.2410 [2]
Ameripol 1501	.2410 [2]
Ameripol 1502	.2410 [2]
Ameripol 1703	.2060 [2]
Ameripol 1705	.2035 [2]
Ameripol 1707	.1910 [2]
Ameripol 1708	.1910 [2]
Ameripol 1710	.1885 [2]
Ameripol 1712	.1885 [2]
Ameripol 4650	.1820 [3]
Ameripol 4651	.1770 [3]
Ameripol 4652	.1425 [3]
Ameripol 4700	.1750 [2]
Ameripol 4701	.1725 [2]
Ameripol 4750	.1545 [3]
ASRC 1000	.2410 [2]
ASRC 1001	.2401 [2]
ASRC 1004	.2401 [2]
ASRC 1006	.2410 [2]
ASRC 1009	.2475 [2]
ASRC 1018	.2700 [2]
ASRC 1019	.2650 [2]
ASRC 1500	.2410 [2]
ASRC 1502	.2410 [2]
ASRC 1503	.2625 [2]
ASRC 1703	.2060 [2]
ASRC 1708	.1910 [2]
ASCR 3110	.2600 [2]
Baytown 1600	.1760 [2]
Baytown 1601	.1760 [2]
Baytown 1602	.1760 [2]
Baytown 1801	.1600 [2]
Carbomix 3750	.1820 [2]
Carbomix 3751	.1545 [2]
Carbomix 3752	.1870 [2]
Carbomix 3753	.1640 [2]
Carbomix 3754	.1790 [2]
Carbomix 3755	.1535 [2]
Copo 1500	.2410 [2]
Copo 1502	.2410 [2]
Copo 1505	.2610 [2]
Copo 1712	.1885 [2]
Copo 1773	.2060 [2]
Copo 1778	.1910 [2]
Copo 3900	.2310 [2]
FR-S 1000	.2410 [2]
FR-S 1001	.2410 [2]
FR-S 1004	.2410 [2]
FR-S 1006	.2410 [2]
FR-S 1009	.2475 [2]
FR-S 1010	.2600 [2]
FR-S 1012	.2425 [2]
FR-S 1013	.2500 [2]
FR-S 1014	.2810 [2]
FR-S 1015	.2910 [2]
FR-S 1500	.2410 [2]
FR-S 1502	.2410 [2]
FR-S 1703	.2060 [2]
FR-S 1705	.2035 [2]
FR-S 1712	.1885 [2]
Naugapol 1016	.2650 [2]
Naugapol 1018	.2700 [2]
Naugapol 1019	.2650 [2]
Naugapol 1021	.3000 [2]
Naugapol 1022	.2800 [2]
Naugapol 1023	.2850 [2]
Naugapol 1503	.2625 [2]
Naugapol 1504	.2950 [2]
Philprene 1000	.2410 [1]
Philprene 1001	.2410 [1]
Philprene 1006	.2410 [1]
Philprene 1009	.2475 [1]
Philprene 1010	.2600 [1]
Philprene 1018	.2700 [1]
Philprene 1019	.2650 [1]
Philprene 1100	.1940 [1]
Philprene 1104	.1900 [1]
Philprene 1500	.2410 [1]
Philprene 1502	.2410 [1]
Philprene 1503	.2625 [1]
Philprene 1600	.1930 [1]
Philprene 1601	.1930 [1]
Philprene 1605	.1900 [1]
Philprene 1703	.2060 [1]
Philprene 1706	.2030 [1]
Philprene 1708	.1910 [1]
Philprene 1712	.1885 [1]
Philprene 1803	.1740 [1]
Plioflex 1006	.2410 [2]
Plioflex 1500C	.2410 [2]
Plioflex 1502	.2410 [2]
Plioflex 1507	.2410 [2]
Plioflex 1703	.2060 [2]
Plioflex 1710C	.1885 [2]
Plioflex 1712C	.1885 [2]
Plioflex 1713	.1750 [2]
Plioflex 1714C	.1725 [2]
Plioflex 1773	.2060 [2]
Plioflex 1778	.1910 [2]
Polysar Krytlex 200	.2510 [2]
Polysar Krylene	.2410 [2]
Polysar Krylene NS	.2410 [2]
Polysar Krynol 651	.1885 [2]
Polysar Krynol 652	.1910 [2]
Polysar S	.2410 [2]
Polysar S-50	.2410 [2]
Polysar S-X 371	.2550 [2]
Polysar SS-250	.2875 [2]
S-1000	.2300 [2]
S-1002	.2325 [2]
S-1006	.2300 [2]
S-1009	.2400 [2]
S-1011	.2325 [2]
S-1013	.2300 [2]
S-1100	.1850 [2]
S-1500	.2300 [2]
S-1502	.2300 [2]
S-1506	.2500 [2]
S-1600	.1825 [2]
S-1602	.1825 [2]
S-1703	.1950 [2]
S-1706	.1925 [2]
S-1707	.1800 [2]
S-1709	.1775 [2]
S-1712	.1775 [2]
S-1803	.1650 [2]
S-1804	.1750 [2]
Synpol 1000	.2410 [1]
Synpol 1001	.2410 [1]
Synpol 1002	.2435 [1]
Synpol 1006	.2410 [1]
Synpol 1007	.2410 [1]
Synpol 1009	.2475 [1]
Synpol 1012	.2425 [1]
Synpol 1013	.2500 [1]
Synpol 1061	.2410 [1]
Synpol 1500	.2410 [1]
Synpol 1502	.2410 [1]
Synpol 1551	.2410 [1]
Synpol 1703	.2060 [1]
Synpol 1707	.1910 [1]
Synpol 1708	.1910 [1]
Synpol 1711	.1900 [1]
Synpol 1712	.1885 [1]

Butyl Rubbers

Enjay Butyl 035 and 150	.2300 [2]
Enjay Butyl 165 NS	.2400 [2]
Enjay Butyl 215	.2300 [2]
Enjay Butyl 217	.2300 [2]
Enjay Butyl 218	.2300 [2]
Enjay Butyl 268 NS	.2400 [2]
Enjay Buty. 325	.2300 [2]
Enjay Butyl 365 NS	.2400 [2]
Polysar Butyl 100	.2450 [2]
Polysar Butyl 101	.2775 [2]
Polysar Butyl 200 and 300	.2450 [2]
Polycar Butyl 301	.2550 [2]
Polysar Butyl 400	.2450 [2]

Chlorosulfonated Polyethylene

Hypalon 20	.7000 [2]
Hypalon 30	.7000 [2]

Neoprene

	(prices f.c.i.)
Neoprene Types AC and CG	.5500 [2]
Neoprene Type AD	.5500 [2]
Neoprene Type FB	.6500 [2]
Neoprene Type GN	.4100 [2]
Neoprene Type GN-A	.4100 [2]
Neoprene Type GRT	.4200 [2]
Neoprene Type KNR	.7500 [2]
Neoprene Type S	.4200 [2]
Neoprene Type W	.3900 [2]
Neoprene Type WB	.4100 [2]
Neoprene Type WHV	.3900 [4]
Neoprene Type WRT	.4500 [2]
Neoprene Type WX	.4100 [2]

Polysulfide Rubbers

	(prices f.c.i.)
Thiokol Type A	.5000 [2]
Thiokol Type FA	.6900 [2]
Thiokol Type ST	1.2500 [2]

Silicone Rubbers*

	(prices f.c.i.)
GE (compounded)	2.50 [2]
GE Silicone Gum (not compounded)	4.00 [2]
Silastic (compounded)	1.90 [2]
Silastic (gums)	3.85 [2]
Union Carbide (gums)	4.00 [2]
Union Carbide (compounds)	2.50 [2]

Latex

(per pound carload)

Butadiene-Acrylonitrile Types

Butaprene N-300	.4600 [1]
Butaprene N-400	.5400 [1]
Butaprene N-401	.5400 [1]
Chemigum 200	.4900 [2]
Chemigum 235	.5400 [2]
Chemigum 236	.5400 [2]
Chemigum 245	.4600 [2]
Chemigum 246	.4600 [2]
Chemigum 247	.4600 [2]
Chemigum 248	.4600 [2]
Hycar 1512	.4600 [2]
Hycar 1551	.5400 [2]
Hycar 1552	.4600 [2]
Hycar 1561	.5400 [2]
Hycar 1562	.4600 [2]
Hycar 1571	.5400 [2]
Hycar 1572	.5100 [2]
Hycar 1577	.4600 [2]
Hycar 1852	.4600 [2]
Nitrex 2612	.4600 [1]
Nitrex 2614	.4600 [1]
Nitrex 2614-A	.4600 [1]
Nitrex 2615	.5100 [1]
Nitrex 2615-A	.5100 [1]
Nitrex 2616	.5400 [1]
Nitrex 2617	.4600 [1]
Nitrex 2617-A	.4600 [1]
Nitrex 2619	.5300 [1]
Nitrex 2620	.4600 [1]
Nitrex 2625	.4600 [1]

POLYMERS

Butadiene-Styrene Types

Copo 2101	.3000 [3]
Copo 2102	.3200 [3]
Copo 2105	.3200 [3]
Copo 2108	.3375 [3]
Copo 2110	.3200 [3]
Copo X-800	.2775 [3]
FR-S 2000	.2775 [3]
FR-S 2001	.2775 [3]
FR-S 2002	.3000 [3]
FR-S 2003	.3050 [3]
FR-S 2004	.3050 [3]
FR-S 2006	.2900 [3]
FR-S 2105	.3200 [3]
Naugatex 2000	.2775 [1]
Naugatex 2001	.2775 [1]
Naugatex 2002	.3000 [1]
Naugatex 2006	.2900 [1]
Naugatex 2105	.3200 [1]
Naugatex 2107	.3200 [1]
Naugatex 2108	.3000 [1]
Pliolite 2000	.2775 [3]
Pliolite 2001	.2775 [3]
Pliolite 2076	.2900 [3]
Pliolite 2104	.3200 [3]
Pliolite 2105	.3200 [3]
Pliolite 2107	.3200 [3]
Pliolite 2108	.3000 [3]
S-2000	.2275 [2]
S-2006	.2150 [2]
S-2101	.2250 [2]
S-2105	.3100 [2]
S-2107	.3200 [2]

Neoprene

Neoprene Latex 60	.4000 [2]
Neoprene Latex 571	.3700 [2]
Neoprene Latex 572	.3900 [2]
Neoprene Latex 601-A	.4000 [2]
Neoprene Latex 673	.5000 [2]
Neoprene Latex 735	.3800 [2]
Neoprene Latex 736	.3800 [2]
Neoprene Latex 842-A	.3700 [2]
Neoprene Latex 950	.4700 [2]

Polysulfide Rubbers

Thiokol Type MX	.8000 [2]
Thiokol Type WD-2	1.2500 [2]
Thiokol Type WD-6	.8000 [2]

Notes: (1) Freight allowed. (2) Freight extra. (3) Freight prepaid. *Covers a wide range of compounds. Readers are urged to check specific prices with producers.

SUPPLIERS

Are Your

Synthetic Rubbers

Listed

in This Section?

if not

Forward full information

to

Market Editor

RUBBER AGE

101 West 31st St.,

New York 1, N. Y.

mixing the Day way at Goodyear.....

DAY BLENDERS . . . selected by the Goodyear Tire & Rubber Co. because these blenders are best suited for their new dry-mixing method for Vinyl compounds. Hundreds of other manufacturers all over the country are profiting from the long, dependable service of these blenders.

Designed for fast, efficient operation, Day Blenders can be equipped with a variety of agitators for your specific product. Anti-friction bearings, metallic seals, spray pipes, flush valves are available as optional equipment.

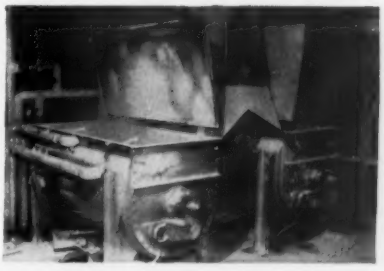


Photo shows two of many Day Blenders being used at the Goodyear Tire & Rubber Co. for mixing a variety of compounds.

Day Blenders are available in capacities from one cubic foot to 2300 cubic feet. Plain, galvanized or stainless steel tanks. Jacketing is optional. Write for Bulletin 800.

FOUNDED 1887

in mixing equipment DAY *means longer life span*

THE J. H. DAY COMPANY

4918 BEECH ST., NORWOOD, CINCINNATI 12, OHIO

Division of Cleveland Automatic Machine Company

Quality equipment for baking, paint and varnish, printing ink, chemical, rubber, pharmaceutical, cosmetics, paper and pulp, explosives, food, ceramics, candy, soap, sugar and milk products.

MARKETS

(continued)

Reclaimed Rubber

The trade reports that a definite increase in reclaimed rubber consumption may be attributed to an upsurge in original tire business. There has also been a continuing increase in the replacement tire segment.

The automobile mat market has worked up to its seasonal peak and even the battery box field reacted to the demand for original equipment. Hose and belting have also picked up somewhat and all of these factors have contributed to the upward movement for reclaim.

While complete figures for 1958 are not yet available, it seems certain that something over 250,000 long tons of reclaimed rubber were produced during the year and better than 240,000 long tons consumed. In 1957, 273,989 were produced and 266,852 long tons consumed. By all accounts, 1958 was a better year for reclaim than many had expected at this time last year, and 1959 promises to be a good year for the industry, many in the trade believe.

(Prices for All Areas Except Calif.)

	per lb.
Premium Grade Whole Tire	.11½
First Line Whole Tire	.11
Second Line Whole Tire	.10½
Third Line Whole Tire	.10¼
Fourth Line Whole Tire	.09½
Black Carcass	.15½
No. 1 Light Colored Carcass	.22
No. 1 Peel	.11
Butyl Tube Reclaim	.14
Natural Rubber Black Tube	.16
Natural Rubber Red Tube	.21
Natural Rubber Gray Tube	.21

Scrap Rubber

Trade factors continue to report a fairly good volume of business in the scrap rubber market. Prices have held at previous levels and give every indication of continuing in this pattern, at least for the next month or so.

The scrap rubber market at year end was more cheerful than it has been for some time. The trade looks forward to the new year with anticipation, hoping to better the 1958 scrap consumption total of about 220,000 long tons. Activity in the automobile industry in the next few months will tell a good part of the story.

(Prices Delivered Akron)

Mixed tires	ton	14.00
Light colored carcass	lb.	.04¾
No. 1 peelings	ton	28.00
No. 2 peelings	ton	25.00
No. 3 peelings	ton	18.00
Buffings	ton	16.00
Truck and Bus S.A.G.	ton	19.00
Passenger S.A.G.	ton	17.00
Natural Rubber Red Tubes	lb.	.07½
Natural Rubber Black Tubes	lb.	.06¾
Butyl Rubber Tubes	lb.	.05½

Tire Fabrics

Three major firms, American Enka, American Viscose and Industrial Rayon, have hiked the prices of "Tyrex" rayon tire yarns: 1100 denier yarn has been increased to 66c a pound, up 3c, while 1650 denier has been boosted to 60c, up 2c. Tyrex, a brand name recently adopted by major rayon producers for their new "super strength" cords, went into volume production for the first time early last summer.

American Enka attributed the increase to "higher research, development and production cost." It has been reported, however, that the increase indicates that rayon producers feel Tyrex cords are doing well enough in their battle with rival nylon to risk narrowing their cost advantage.

Rayon tire yarn prices in general haven't changed since 1956. Early that year, they were raised 5 to 6c a pound, but a series of later price cuts prompted by the competitive battle with nylon more than wiped out that increase later in the year. Rayon men believe the increased strength of Tyrex and some other advantages will allow their yarns to compete with nylon on both a quality and a price basis.

Nylon Cord Sales Increase

DuPont has issued a statement estimating that 44 per cent of all passenger tire replacement sales in 1958 were nylon cord tires. The estimate is based on a report from service station chains and special tire sales organizations, such as mail order houses, auto supply stores and farm cooperatives. It is claimed that there is a rising trend in the sales rate of nylon cord tires in the replacement field. Nearly 50 per cent of all tires sold as replacements are said to be constructed with nylon cord.

Oil companies and special brand marketers account for one-half of total replacement sales of passenger tires in the country. Their sales are said to be running about 4 per cent above 1957 figures. Nylon's share of this segment of the tire market in 1958 will have been more than double the 20 per cent held in 1956.

(Prices f.o.b. Shipping Point)

Rayon Tire Cord

1100	lb.	.73
1650	lb.	.67
2200	lb.	.67½

Nylon Tire Cord

210	lb.	1.95
840	lb.	1.70

Rayon Graded Fabric

1100	lb.	.69
1650	lb.	.63½
2200	lb.	.63

Cotton Chafers

8.9 oz. (per square yard)	lb.	.68
9.25 oz. (per square yard)	lb.	.66
11.65 oz. (per square yard)	lb.	.62
14.4 oz. (per square yard)	lb.	.71

Liquid Latex

Natural rubber latex, centrifuged concentrated Hevea Latex, prices and availabilities have undergone a substantial change during recent months. Beginning in the second quarter of 1958, there was a "glut" of supplies and extreme "distressed" prices appeared. Statistics then available showed an abnormally low consumption of under 5,000 tons monthly. Buyers were pessimistic and placed forward orders for only partial requirements.

Producers and United States importers cut back production and imports because of low offtake and price levels showing losses to them. The general United States business "upturn", a more optimistic tone from automotives, and an upturn in demand in Europe, Australia, Japan and other areas, changed the over-all picture. United States stocks, standing at 17,604 tons at the end of May 1958, were reported to be under 10,000 tons at the end of October 1958.

An authoritative statistical report shows that an imbalance is expected through mid-1959, with consumption estimates substantially greater than available supplies from imports. Supplies will be limited by the rainy season coming up in early 1959.

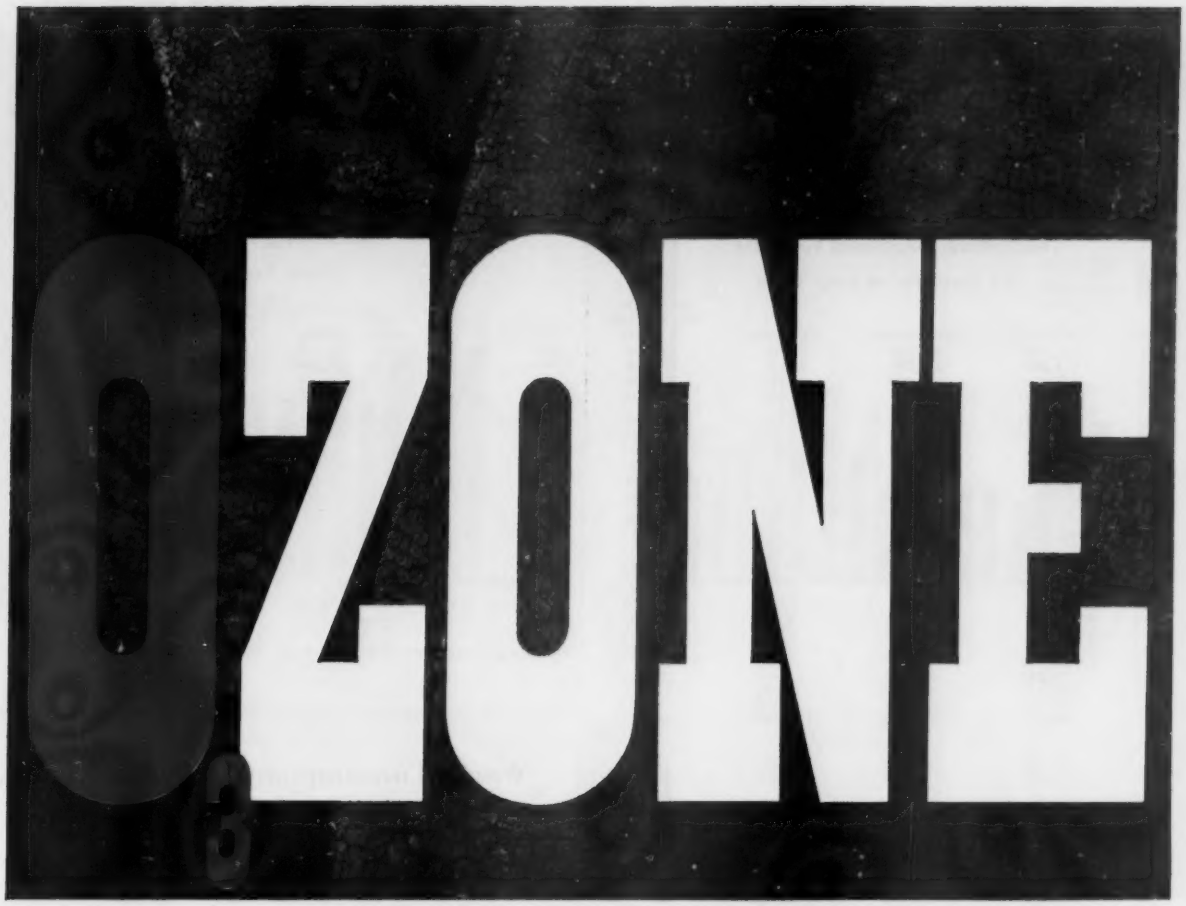
Latex sunk to between 30 and 31c during May 1958 and, with all the statistical factors enumerated above, rose to as high as 38c a pound during November. Since then, affected by a decline in crude natural rubber prices caused by a withdrawal of communist buying and believed to be temporary, the price dipped to around 35c, the level at which it now hovers.

Demand is firm and supplies out of balance and insufficient. Producers, observing the market to determine its constancy, do not appear to have resumed larger production. It is evident that the tight position can continue to be pressing should consumption continue at current levels of over 7,873 tons (October 1958) per month.

Cotton

The price of middling uplands cotton on the New York Cotton Exchange has moved in a range of 49 points since our last report (December 1), high for the period being 36.05c, reached on December 1, and low being 35.70c, from December 15 through December 31. The average price of middling uplands for December was 35.75c based upon 21 trading days. This compares with an average of 36.24c in November.

Representative Harold D. Cooley (D., N.C.) has indicated that Congress may try to enact a one price cotton bill in 1960, but he doubts the Administration would accept it. Mr. Cooley favors a cash subsidy plan which would allow domestic sale of raw cotton, probably at the world price, with farmers getting Compensatory payments from the government, which would be the difference between the world price and a high level set by the government as a support level.



How to arrest its attack on rubber products

Ozone attack is now recognized as the major cause of cracking and checking in stressed rubber products.

The mechanism of this type of deterioration is attributed to the chemical attack of ozone upon the carbon-to-carbon double bonds of unsaturated elastomers. Through a rather complex reaction the double bond is broken. This places additional stress upon adjacent chains and increases their sensitivity to ozone attack. Thus a continuing reaction occurs, leading to the development of fissures perpendicular to the direction of the stress.

To combat the deteriorating effects of ozone, rubber chemists have several approaches open to them:

(1) Addition of waxes which migrate to surface areas

(2) Protection of surface areas with an inert coating

(3) Incorporation of antiozonants

Of these three methods, the use of antiozonants is the most effective for rubber products under stress. Antiozonants are easily incorporated into the rubber during processing and slowly exude to the surface during use. Because they interrupt the chain-breaking reaction between ozone and unsaturated elastomers, antiozonants provide a continuing protection which cannot be equalled by any physical method.

Eastman's Eastozone antiozonants protect rubber products more effectively at lower cost than do other types of commercially-used antiozonants. Using Eastozone antiozonants, compounders often can cut antiozonant requirements in half and still get the same ozone resistance, measured by static or dynamic exposure tests.

Give your mechanical goods or tire stocks maximum service life at minimum cost by incorporating Eastozone antiozonants in your rubber recipes. Ask your Eastman representative for samples and a copy of Bulletin 1-102 "*Eastozone Antiozonants for the Rubber Industry*" or write to EASTMAN CHEMICAL PRODUCTS, INC., subsidiary of Eastman Kodak Company, KINGSPORT, TENNESSEE.

Chemical Description of Eastman Antiozonants

Eastozone 30 ..... N, N'-Di-2-octyl-p-phenylenediamine
Eastozone 31 ..... N, N'-Di-3-(5-methylheptyl)-p-phenylenediamine

Eastozone Eastman Rubber Antiozonants

SALES OFFICES: Eastman Chemical Products, Inc., Kingsport, Tennessee; New York City; Framingham, Massachusetts; Cincinnati; Cleveland; Chicago; St. Louis; Houston. **West Coast: Wilson Meyer Co.,** San Francisco; Los Angeles; Portland; Salt Lake City; Seattle.

STATISTICS of the industry

PERTINENT INDUSTRY DATA

Natural Rubber in the United States

(Including Latex and Guayule)

(All Quantities in Long Tons)

Year	New Supply	Consumption	Re-Exports	Stocks On Hand at End of Period
1931	501,788	355,200	25,609	322,000
1932	414,668	336,700	20,937	379,000
1933	418,902	412,400	20,576	365,000
1934	463,018	462,500	23,856	355,000
1935	467,146	495,300	11,391	303,000
1936	488,145	575,000	12,582	223,000
1937	600,479	543,600	7,902	262,204
1938	411,983	437,031	5,652	231,500
1939	499,473	592,000	13,125	125,800
1940	818,243	648,500	7,060	288,864
1941	1,029,007	775,000	5,376	533,344
1942	282,653	376,791	10,856	422,714
1943	55,329	317,634	20,815	139,594
1944	107,834	144,113	9,665	93,650
1945	135,672	105,429	6,743	118,715
1946	400,687	277,597	4,338	237,467
1947	688,354	562,661	4,101	129,038
1948	735,227	627,332	6,673	141,541
1949	660,792	574,522	6,253	106,619
1950	802,249	720,268	8,644	89,215
1951	733,048	454,015	2,603	76,569
1952	805,997	453,846	3,024	95,260
1953	647,150	553,473	8,376	112,316
1954	596,848	596,285	7,443	104,543
1955	635,174	634,800	10,611	110,105
1956	580,510	563,095	11,300	115,949
1957	499,121	539,761	10,146	100,901
1957:				
Nov.	44,583	43,696	1,225	97,754
Dec.	44,544	38,038	1,000	100,473
1958:				
Jan.	45,564	42,597	706	104,979
Feb.	52,546	36,711	903	110,880
Mar.	41,986	38,191	1,150	112,863
Apr.	31,511	36,608	1,395	107,897
May	29,237	36,014	1,707	100,985
June	28,279	37,607	1,634	91,779
July	27,521	34,235	3,107	85,577
Aug.	39,057	39,444	1,369	85,666
Sept.	38,321	44,814	1,019	82,622
Oct.	40,267	48,957	1,550	77,859
Nov.	42,484	43,877	3,140	75,335

Source: U. S. Department of Commerce.

U. S. Imports of Natural Rubber

Year	Dry: Long Tons	Dry: Declared Value	Latex: Long Tons	Latex: Declared Value	Total Imports
1936	467,064	152,072,496	19,852	6,659,899	486,916
1937	574,600	237,307,041	23,185	10,213,670	597,785
1938	397,640	125,373,864	11,944	4,168,127	409,584
1939	469,946	167,586,780	27,437	10,467,552	497,383
1940	781,202	303,308,823	33,789	14,593,466	814,991
1941	989,498	401,976,317	34,797	15,965,627	1,024,245
1942	266,276	112,537,426	10,646	5,630,667	276,922
1943	50,358	31,369,198	1,890	1,312,202	52,248
1944	103,847	73,908,549	3,091	2,092,211	106,938
1945	134,408	95,814,102	4,773	3,115,853	139,181
1946	376,502	228,796,110	8,421	5,843,085	384,923
1947	691,087	306,951,814	17,542	9,787,722	708,629
1948	702,293	290,849,177	32,745	18,288,223	735,038
1949	630,808	225,343,624	29,743	14,968,650	660,551
1950	747,109	416,222,598	54,401	41,764,486	801,510
1951	677,874	727,343,348	54,963	80,178,309	732,837
1952	756,987	578,179,519	48,228	40,563,116	805,215
1953	571,635	284,909,223	75,511	46,353,333	647,146
1954	522,364	219,098,143	74,483	42,755,029	596,847
1955	542,507	360,435,303	92,825	80,163,114	635,332
1956	499,479	334,990,045	71,709	61,795,844	564,321
1957	475,958	291,337,628	78,567	58,249,788	554,174
1957:					
Nov.	38,087	22,885,060	6,496	4,688,156	44,583
Dec.	46,350	26,243,338	7,572	5,141,999	53,922
1958:					
Jan.	39,275	20,938,606	6,290	4,210,554	45,565
Feb.	39,005	20,299,708	7,013	4,787,054	46,018
Mar.	32,740	16,891,665	7,147	4,736,971	39,887
Apr.	28,582	14,476,348	6,348	4,148,636	34,930
May	27,941	13,520,935	4,121	2,760,020	32,062
June	23,596	11,000,264	4,323	2,741,928	27,919
July	22,665	10,305,428	3,158	2,002,980	25,823
Aug.	33,917	15,957,912	5,140	3,097,894	39,057

Source: Bureau of the Census, U. S. Department of Commerce.

World Production of Natural Rubber

(Including Latex)

(Long Tons)

Year	Malaya	Indonesia	Ceylon	Viet Nam & Cambodia	Latin America*	Rest of World*	Total*
1947	646,362	277,951	89,000	38,128	34,928	172,782	1,260,000
1948	698,189	432,349	95,000	43,935	29,158	225,557	1,525,000
1949	671,503	432,996	89,500	43,010	27,318	225,659	1,490,000
1950	694,090	696,472	113,500	48,482	26,902	280,299	1,860,000
1951	605,346	814,406	105,000	52,136	29,777	278,262	1,885,000
1952	584,238	750,494	96,500	63,134	35,475	261,211	1,790,000
1953	574,390	692,164	98,610	74,545	35,318	250,182	1,725,000
1954	584,435	738,670	93,935	78,024	26,833	280,112	1,802,500
1955	639,128	733,786	93,830	80,172	6,000	344,584	1,897,500
1956	568,550	686,667	95,389	89,072	22,457	336,015	1,857,000
1957	638,706	684,515	98,164	58,440	28,351	381,824	1,890,000
1958:							
Mar.	48,663	47,279	6,938	1,740	3,567	31,813	140,000
Apr.	44,962	40,775	9,763	5,628	2,405	23,967	127,500
May	45,398	37,779	8,516	5,324	500	32,483	130,000
June	53,105	45,731	5,646	5,526	500	34,492	145,000
July	60,376	66,099	8,263	6,090	500	33,672	175,000
Aug.	58,807	62,413	8,925	5,425	500	33,930	170,000
Sept.	57,355	57,659	8,021	.....	500	41,465	165,000

Source: International Rubber Study Group. * Estimated.

World Consumption of Natural and Synthetic Rubber

(Including Latex)

(Long Tons)

Year	United States	United Kingdom	Canada	Europe*	Rest of World*	Total*
1946	1,039,296	126,770	39,196	145,000	115,804	1,467,500
1947	1,122,327	156,399	61,452	242,500	153,548	1,735,000
1948	1,069,404	196,286	62,121	392,000	182,379	1,902,500
1949	988,903	186,622	56,362	446,500	207,388	1,887,500
1950	1,258,557	222,425	68,695	448,500	287,055	2,285,000
1951	1,214,298	238,101	70,809	476,500	314,941	2,312,500
1952	1,261,413	202,179	67,099	550,000	254,901	2,335,000
1953	1,338,309	211,453	73,394	521,000	343,606	2,500,000
1954	1,233,012	247,612	71,656	544,250	408,094	2,505,000
1955	1,529,699	266,804	84,528	630,000	464,250	2,980,000
1956	1,436,482	232,345	91,458	775,500	489,215	3,025,000
1957	1,464,640	239,021	88,379	777,250	565,710	3,135,000
1958:						
Mar.	104,231	23,481	5,907	74,750	49,131	257,500
Apr.	103,221	18,071	6,439	82,500	52,269	262,500
May	102,318	20,165	6,836	73,750	41,931	245,000
June	107,413	22,023	7,701	85,000	52,863	275,000
July	98,100	17,410	6,816	69,750	50,424	242,500
Aug.	111,206	11,763	5,454	61,750	52,327	242,500
Sept.	123,275	22,596	8,139	.....	143,490	297,500

Source: International Rubber Study Group. * Estimated.

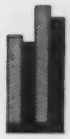
Rim Production

	1953	1954	1955	1956	1957
Passenger Car	31,318,461	25,952,322	38,092,080	27,109,610	27,301,567
Truck & Bus	5,228,831	4,463,689	6,642,329	6,315,428	5,468,223
Agricultural	1,943,489	1,279,040	1,931,768	1,416,938	1,368,127
Earth Mover	24,685	21,536	38,849	88,812	67,289
Total	38,514,954	31,734,587	46,705,036	34,930,788	34,205,206

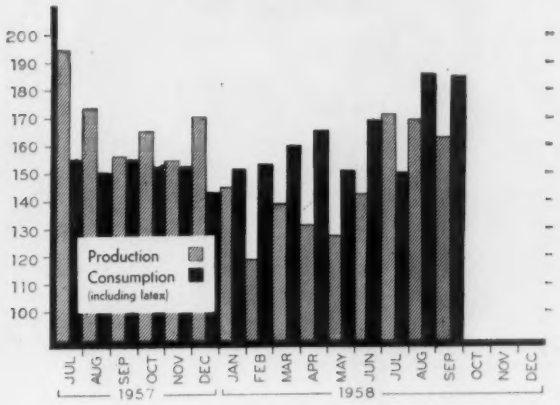
	1958					
	June	July	Aug.	Sept.	Oct.	Nov.
Passenger Car	1,431,337	1,306,276	999,623	1,466,800	1,921,856	2,101,264
Truck & Bus	318,248	318,952	214,813	325,764	350,833	408,232
Agricultural	65,173	76,525	61,286	61,021	100,293	87,715
Earth Mover	8,049	2,137	6,492	7,830	2,925	3,680
Total	1,822,807	1,703,880	1,282,214	1,861,415	2,375,907	2,600,891

Source: The Tire & Rim Association, Inc.

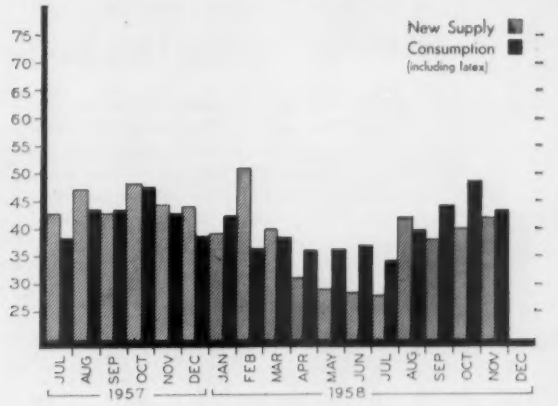
STATISTICS at a glance



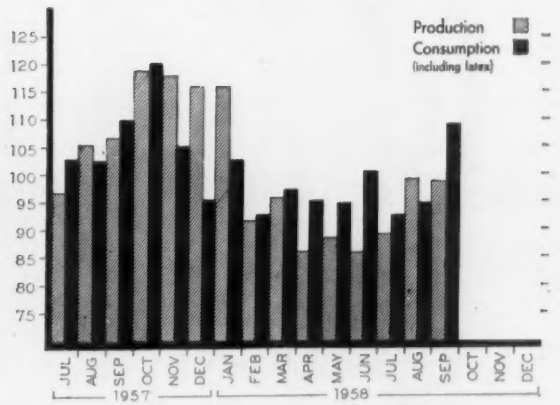
NATURAL RUBBER—WORLD
(thousands of long tons)



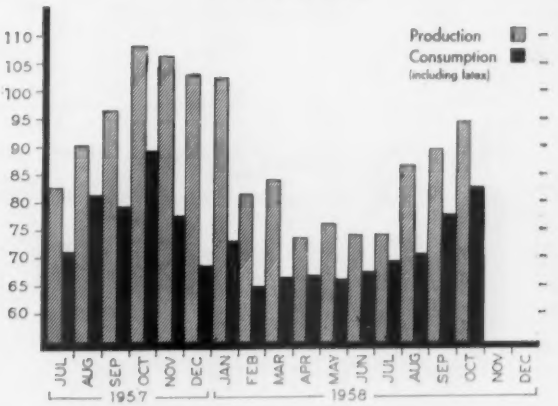
NATURAL RUBBER—UNITED STATES
(thousands of long tons)



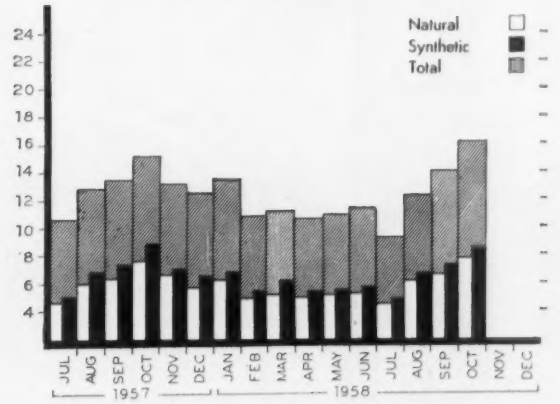
SYNTHETIC RUBBER—WORLD
(thousands of long tons)



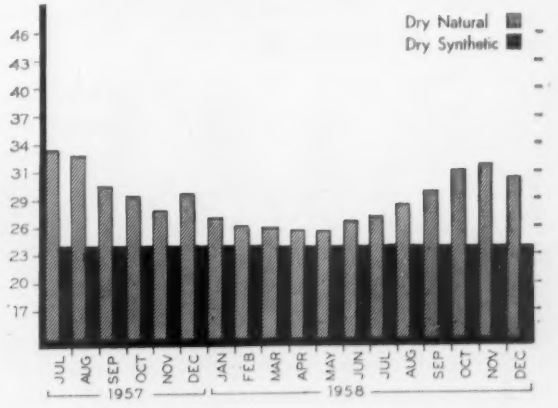
SYNTHETIC RUBBER—UNITED STATES
(thousands of long tons)



LATEX CONSUMPTION—UNITED STATES
(thousands of long tons)



PRICES—NATURAL AND SYNTHETIC
(cents per pound)



Synthetic Rubber in the United States

(All Quantities in Long Tons)

New Supply

Year	GR-S	Neoprene	Butyl	N-Type	Total
1949	310,599	35,215	54,046	11,072	410,932
1950	378,887	50,067	60,915	12,037	501,906
1951	704,529	38,907	76,475	15,333	855,244
1952	654,854	65,745	81,630	16,228	818,447
1953	680,728	80,495	79,801	20,198	861,222
1954	490,405	69,150	58,802	21,396	639,753
1955	801,145	91,357	56,179	32,623	982,304
1956	876,982	99,412	75,873	34,547	1,086,814
1957	913,321	110,721	67,418	33,618	1,125,078
1958:					
Jan.	85,828	8,804	6,189	2,419	103,240
Feb.	66,693	8,200	5,038	2,198	82,129
Mar.	69,650	7,671	4,808	2,082	84,211
Apr.	59,677	7,973	4,406	2,249	74,305
May	62,642	7,450	4,512	2,369	76,973
June	63,032	7,251	2,080	2,327	74,690
July	64,944	6,248	3,907	2,221	77,320
Aug.	73,338	6,745	4,725	2,824	87,632
Sept.	75,111	8,586	4,117	3,165	90,979
Oct.	82,741	9,283	....	3,619	95,643

Consumption

1950	416,230	43,781	66,348	11,930	538,289
1951	626,444	48,887	70,500	13,066	758,897
1952	666,420	55,522	71,229	13,866	807,037
1953	624,181	65,900	77,826	16,929	784,836
1954	500,345	57,203	61,464	17,715	636,727
1955	741,997	72,876	53,991	26,035	894,899
1956	727,789	74,887	49,615	24,976	877,267
1957	767,218	75,461	55,413	25,187	923,279
1958:					
Jan.	60,179	5,928	4,508	2,010	72,625
Feb.	52,962	5,045	4,255	1,968	64,230
Mar.	54,816	4,965	4,297	1,962	66,040
Apr.	55,133	4,962	4,621	1,897	66,613
May	55,463	4,805	4,258	1,778	66,304
June	58,507	4,844	4,402	2,053	69,806
July	53,903	4,454	3,791	1,717	63,865
Aug.	59,458	5,719	4,277	2,308	71,762
Sept.	64,860	6,405	4,725	2,471	78,461
Oct.	73,242	7,105	....	2,826	83,033

Exports

1950	900	4,826	31	1,895	7,652
1951	483	6,825	216	1,725	9,249
1952	9,467	9,813	126	2,695	22,101
1953	7,692	11,494	237	3,245	22,668
1954	11,069	12,062	2,831	4,155	30,117
1955	60,704	18,098	9,895	4,593	93,290
1956	112,366	21,909	8,699	6,194	149,168
1957	157,977	30,242	8,748	6,377	203,344
1957:					
Dec.	15,549	2,447	814	563	19,373
1958:					
Jan.	14,109	2,649	1,626	513	18,897
Feb.	9,947	2,626	1,415	378	14,366
Mar.	15,647	3,424	757	410	20,238
Apr.	11,583	2,356	949	698	15,586
May	14,067	2,899	1,218	784	18,968
June	11,993	1,562	1,022	473	15,050
July	10,602	2,403	1,051	674	14,730
Aug.	8,521	2,603	972	558	12,654
Sept.	....	2,774	812	518	4,104

Stocks

1949	77,731	4,654	12,224	3,433	98,042
1950	36,942	5,733	7,243	2,840	52,758
1951	105,271	8,379	12,481	3,821	129,912
1952	83,861	8,535	22,716	3,875	118,987
1953	135,153	11,480	24,866	4,346	175,845
1954	115,499	11,149	19,267	4,280	150,395
1955	108,989	12,220	10,500	6,030	137,739
1956	151,763	14,077	28,744	7,934	202,518
1957	140,199	18,843	31,489	7,454	197,985
1958:					
Jan.	152,441	18,691	31,753	7,512	210,397
Feb.	151,501	18,409	31,369	7,635	208,914
Mar.	153,221	18,504	30,796	6,947	209,468
Apr.	143,981	18,764	30,012	6,469	199,226
May	137,277	19,014	29,246	6,392	191,929
June	132,800	18,763	25,954	6,231	183,721
July	132,303	18,242	24,882	6,097	181,524
Aug.	136,735	16,344	24,618	6,224	183,921
Sept.	138,987	15,154	22,554	6,145	182,840
Oct.	134,613	15,474	.....	6,356	156,443

Source: U. S. Department of Commerce.

Natural and Synthetic Rubber Latex in the United States

(All Quantities in Long Tons)

New Supply

Year	Natural	GR-S	Neoprene	N-Type	Total Synthetic	Grand Total
1945	4,768	15,176	7,077	.....	22,253	27,021
1946	8,012	24,810	13,595	.....	38,405	46,417
1947	17,675	22,474	6,089	.....	28,563	46,238
1948	32,630	21,494	5,022	.....	26,516	59,146
1949	29,974	21,357	3,651	.....	25,008	54,982
1950	54,401	31,339	5,725	.....	37,064	91,465
1951	54,963	32,972	6,866	2,948	42,786	97,749
1952	48,228	42,273	7,598	4,164	54,035	102,263
1953	75,511	48,112	9,026	5,844	62,982	138,493
1954	74,483	48,379	8,214	6,866	63,459	137,942
1955	92,754	69,364	10,432	10,798	90,594	183,348
1956	72,013	69,720	10,642	10,650	91,012	163,025
1957	72,252	74,535	10,403	11,420	96,358	168,610
1957:						
Nov.	6,496	6,515	1,021	994	8,530	15,026
Dec.	7,572	5,915	704	734	7,353	14,925
1958:						
Jan.	6,289	5,998	788	785	7,571	13,860
Feb.	7,013	3,852	765	671	5,288	12,301
Mar.	7,147	4,880	759	787	6,426	13,573
Apr.	6,348	3,889	907	830	5,626	11,974
May	4,121	3,635	808	882	5,325	9,446
June	4,323	4,539	696	890	6,125	10,448
July	3,158	3,645	677	893	5,215	8,373
Aug.	5,140	5,474	892	1,103	7,469	12,609
Sept.	4,810	6,165	1,075	1,173	8,413	13,223
Oct.	5,878	7,617	1,170	1,308	10,095	15,973

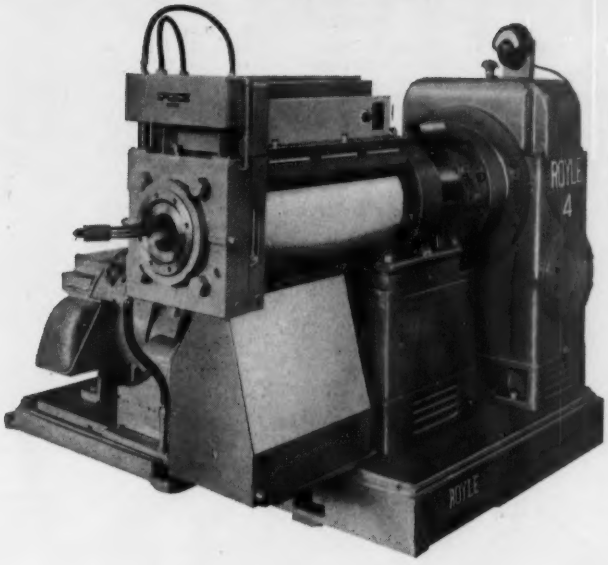
Consumption[1]

1945	3,886	14,500	6,800	....	21,300	25,186
1946	5,714	23,500	13,000	....	36,500	42,214
1947	13,909	22,500	6,500	....	29,000	42,909
1948	28,489	21,500	5,250	....	26,750	55,239
1949	36,117	21,500	3,750	....	25,250	61,367
1950	56,138	31,000	5,500	....	36,500	92,638
1951	46,750	31,031	6,279	2,628	39,938	86,688
1952	53,567	40,562	7,368	3,093	51,023	104,590
1953	67,375	46,473	7,981	3,654	58,108	125,483
1954	75,931	44,173	7,251	4,507	55,931	131,862
1955	86,478	63,982	8,736	8,495	81,213	167,691
1956	74,082	62,762	8,708	8,021	79,491	153,573
1957	75,009	68,305	9,039	8,630	85,974	160,983
1957:						
Nov.	6,650	5,862	725	712	7,299	13,949
Dec.	5,816	5,338	651	606	6,595	12,411
1958:						
Jan.	6,380	5,438	806	683	6,927	13,307
Feb.	5,380	4,475	640	806	5,921	11,301
Mar.	5,560	4,708	633	720	6,061	11,621
Apr.	4,847	4,093	707	797	5,597	10,444
May	5,004	4,102	785	795	5,682	10,686
June	5,304	4,165	639	919	5,723	11,027
July	4,531	3,433	629	703	4,765	9,296
Aug.	6,094	4,654	764	1,025	6,443	12,537
Sept.	6,748	5,779	820	1,017	7,616	14,364
Oct.	7,725	6,534	979	1,120	8,633	16,358

Stocks at End of Period

1945	3,121	....	....	....	....	3,121
1946	4,865	....	....	....	....	4,865
1947	5,033	....	....	....	....	5,033
1948	11,235	....	....	....	....	11,235
1949	5,063	....	....	....	....	5,063
1950	4,927	....	....	....	....	4,927
1951	4,752	3,727	1,245	532	5,504	10,256
1952	6,201	5,040	1,019	902	6,961	13,162
1953	13,532	4,794	1,117	721	6,632	20,164
1954	11,133	5,134	1,087	811	7,032	18,165
1955	13,203	6,980	1,236	1,807	10,203	23,406
1956	12,064	7,451	1,384	1,558	10,393	22,457
1957	14,454	8,347	1,267	1,974	11,588	26,042
1957:						
Nov.	12,316	7,558	1,265	1,927	10,750	23,066
Dec.	14,454	8,662	1,267	1,974	11,903	26,357
1958:						
Jan.	14,178	8,222	1,190	2,052	11,464	25,642
Feb.	15,506	7,992	1,251	2,297	11,540	27,046
Mar.	16,825	7,991	1,281	1,974	11,246	28,071
Apr.	17,415	7,756	1,398	1,744	10,898	28,313
May	17,604	7,240	1,292	1,732	10,264	27,868
June	17,078	7,337	1,267	1,888	10,492	27,570
July	15,516	6,693	1,312	1,990	9,995	25,511
Aug.	13,750	7,166	1,195	2,049	10,410	24,160
Sept.	12,482	7,166	1,354	2,096	10,616	23,098
Oct.	10,324	6,842	1,365	2,229	10,376	20,700

Source: U. S. Department of Commerce.
Note: (1) GR-S and Neoprene consumption estimated through 1950.



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Automotive Pneumatic Casings

(Thousands of Units)

	Shipments					
	Original Equipment	Replacement	Export	Total	Production	Inventory End of Period
1951 (total)	32,153	44,612	1,677	78,442	83,405	8,765
Passenger Car.	26,729	34,246	723	61,678	65,546	6,973
Truck and Bus	5,424	10,386	954	16,764	17,859	1,791
1952 (total)	29,484	54,342	1,520	85,346	90,411	14,110
Passenger Car.	24,106	45,458	741	70,305	74,341	11,251
Truck and Bus	5,378	8,884	779	15,041	16,070	2,859
1953 (total)	37,949	55,124	1,543	94,617	96,150	15,720
Passenger Car.	33,106	45,798	809	79,713	81,455	13,044
Truck and Bus	4,843	9,326	734	14,904	14,696	2,676
1954 (total)	33,333	55,155	1,753	90,241	89,141	14,762
Passenger Car.	29,741	47,044	928	77,713	76,794	12,217
Truck and Bus	3,591	8,111	826	12,528	12,347	2,545
1955 (total)	47,374	59,246	1,879	108,499	112,178	18,778
Passenger Car.	42,574	50,189	966	93,730	97,223	15,963
Truck and Bus	4,800	9,057	912	14,769	14,955	2,815
1956 (total)	35,422	62,146	1,757	99,325	100,406	79,872
Passenger Car.	30,873	53,252	875	85,000	85,546	16,494
Truck and Bus	4,548	8,894	883	14,325	14,859	3,378
1957 (total) ...	36,765	65,150	1,733	103,649	106,940	250,536
Passenger Car.	32,725	56,603	889	90,217	93,542	210,146
Truck and Bus	4,053	8,546	846	13,432	13,398	40,384
1957:						
Oct. (total)	2,620	5,351	182	8,154	9,708	20,985
Passenger Car.	2,298	4,392	88	6,778	8,437	17,998
Truck and Bus	322	960	94	1,375	1,271	2,987
Nov. (total)	3,398	3,630	143	7,171	8,248	22,178
Passenger Car.	3,098	3,049	74	6,220	7,098	18,960
Truck and Bus	301	581	70	951	1,150	3,211
Dec. (total)	3,070	3,342	148	6,559	7,615	23,225
Passenger Car.	2,803	2,858	78	5,739	6,597	19,818
Truck and Bus	267	484	70	820	1,018	3,408
1958:						
Jan. (total)	2,653	5,511	107	8,271	7,814	22,769
Passenger Car.	2,377	4,838	50	7,264	6,740	19,299
Truck and Bus	277	674	57	1,007	1,074	3,470
Feb. (total)	2,253	4,374	110	6,737	7,314	23,392
Passenger Car.	1,998	3,777	57	5,833	6,320	19,820
Truck and Bus	254	598	52	904	994	3,572
Mar. (total)	2,114	5,334	95	7,543	7,573	23,446
Passenger Car.	1,845	4,726	49	6,621	6,569	19,786
Truck and Bus	269	608	46	923	1,004	3,659
Apr. (total)	1,876	6,183	116	8,175	7,477	22,658
Passenger Car.	1,594	5,517	61	7,173	6,522	19,051
Truck and Bus	282	666	55	1,002	955	3,607
May (total)	2,173	6,220	110	8,503	7,653	21,834
Passenger Car.	1,874	5,593	56	7,523	6,715	18,263
Truck and Bus	299	626	54	980	938	3,571
June (total)	1,932	7,182	117	9,231	8,293	20,920
Passenger Car.	1,667	6,387	63	8,117	7,306	17,465
Truck and Bus	265	794	54	1,113	988	3,456
July (total)	2,020	7,442	111	9,573	7,288	18,615
Passenger Car.	1,756	6,502	60	8,318	6,368	15,501
Truck and Bus	265	940	51	1,255	920	3,114
Aug. (total)	1,055	6,679	115	7,848	7,762	18,521
Passenger Car.	847	5,807	57	6,711	6,753	15,535
Truck and Bus	208	871	57	1,137	1,009	2,986
Sept. (total)	1,442	6,365	105	7,912	8,277	18,925
Passenger Car.	1,170	5,425	64	6,659	7,134	16,045
Truck and Bus	271	940	41	1,253	1,143	2,880
Oct. (total)	1,838	6,476	140	8,454	9,344	19,913
Passenger Car.	1,522	5,369	81	6,972	7,983	17,134
Truck and Bus	316	1,106	59	1,482	1,361	2,779

Source: The Rubber Manufacturers Association, Inc.

Automobile Production in U. S.

(Civilian Production Only)

Year	Passenger Cars	Trucks	Total	Year	Passenger Cars	Trucks	Total
1938	2,000,985	485,852	2,486,837	1948	3,909,270	1,363,856	5,273,126
1939	2,866,796	704,308	3,571,104	1949	5,108,841	1,123,736	6,232,577
1940	3,692,328	721,637	4,413,965	1950	6,665,836	1,332,263	7,998,099
1941	3,744,500	875,381	4,619,681	1951	5,337,729	1,420,432	6,758,161
1942	220,814	133,083	353,897	1952	4,320,794	1,212,790	5,533,584
1943	0	4,501	4,501	1953	6,121,787	1,202,196	7,323,983
1944	0	124,819	124,819	1954	5,558,897	1,038,045	6,596,942
1945	83,792	313,643	397,435	1955	7,920,186	1,245,018	9,165,204
1946	2,148,699	930,760	3,079,429	1956	5,816,109	1,100,417	6,916,526
1947	3,558,178	1,220,634	4,778,812	1957	6,113,344	1,097,006	7,210,350
1957:							
Jan.	628,045	91,117	719,162	July	484,718	96,048	580,766
Feb.	570,023	91,767	661,790	Aug.	521,282	90,152	611,434
Mar.	585,734	91,703	676,437	Sept.	318,279	63,131	381,410
Apr.	541,733	105,175	646,908	Oct.	291,064	88,879	379,943
May	537,112	102,312	639,424	Nov.	583,783	94,574	678,357
June	496,329	94,321	590,650	Dec.	555,242	87,327	642,569
1958:							
Jan.	478,416	79,790	558,206	July	316,408	65,048	381,456
Feb.	396,221	71,024	467,245	Aug.	194,974	55,227	250,201
Mar.	359,464	73,668	433,332	Sept	102,687	46,358	149,045
Apr.	322,482	73,899	396,381	Oct.	272,241	69,979	342,220
May	352,076	75,303	427,379	Nov.	.....	.....	.....
June	342,228	70,663	412,891	Dec.	.....	.....	.....

Source: Automobile Manufacturers Association.
Note: Figures are based on factory sales. Revisions are made from time to time in these figures and the latest issue should be consulted for accuracy.

Automotive Inner Tubes

(Thousands of Units)

Year	Shipments: Original Equipment	Shipments: Replacement	Shipments: Export	Shipments: Total	Production	Inventory End of Period
1946	15,327	59,357	1,424	76,108	77,251	3,820
1947	25,046	46,560	2,483	74,088	79,181	8,059
1948	26,833	40,548	1,119	68,499	70,033	9,641
1949	31,521	31,450	887	63,858	65,114	10,657
1950	41,240	42,671	811	84,723	80,179	...
1951	32,151	32,284	1,071	65,507	67,249	10,094
1952	29,451	32,985	1,034	63,449	65,073	12,036
1953	37,957	36,072	878	74,907	74,425	11,874
1954	25,071	35,576	945	61,593	48,279	9,519
1955	5,001	33,387	1,001	39,389	35,900	6,833
1956	3,100	32,358	1,040	36,498	34,405	6,109
1957	3,046	35,687	1,076	39,806	39,774	80,077
1957:						
Dec.	225	2,392	101	2,717	2,778	7,671
1958:						
Jan.	232	4,005	72	4,309	3,344	6,700
Feb.	209	3,014	73	3,412	3,444	6,866
Mar.	209	3,481	74	3,764	3,685	7,066
Apr.	201	2,978	64	3,243	3,624	7,609
May	225	2,742	68	3,035	3,530	8,189
June	202	3,332	67	3,602	3,476	8,156
July	215	3,174	76	3,466	2,890	7,680
Aug.	160	3,097	74	3,331	3,305	7,664
Sept.	207	3,228	63	3,498	3,390	7,657
Oct.	244	3,238	84	3,567	3,768	7,869

Source: The Rubber Manufacturers Association, Inc.

Vinyl and Vinyl Copolymer Resins—Sales

(Thousands of Pounds—Resin Content)

	Polyvinyl Chloride and Copolymer Resins							All Other Vinyl Resins		
	Film	Sheeting	Molding & Extrusion	Textile & Paper Treating	Flooring	Protective Coatings	All Other Uses	Adhesives	All Other Uses	Grand Total
1953	63,691	62,385	129,215	52,353	22,152	22,823	27,790	22,411	77,478	480,299
1954	69,943	56,588	147,284	49,546	34,890	23,676	35,148	26,609	74,090	517,773
1955	83,276	51,424	183,736	64,223	56,357	27,439	53,868	31,853	105,644	657,821
1956	78,063	55,598	206,726	62,931	65,384	28,522	71,859	36,563	115,151	720,799
1957	90,543	56,344	216,517	66,392	81,357	31,519	50,637	41,665	113,396	748,370
1957:										
Sept.	9,406	4,987	18,653	6,542	7,156	2,363	4,189	3,191	8,771	65,258
Oct.	10,747	5,102	21,712	6,802	7,506	2,256	4,466	3,771	10,887	73,249
Nov.	5,569	5,143	16,940	6,151	6,224	1,916	6,211	3,197	9,265	60,615
Dec.	4,231	4,396	14,002	3,936	6,176	2,073	5,345	2,896	8,292	51,347
1958:										
Jan.	5,870	4,119	16,361	4,035	7,562	2,885	4,071	3,213	10,780	58,896
Feb.	5,902	4,412	13,907	4,468	7,964	2,250	3,369	3,484	9,193	54,949
Mar.	6,530	4,248	15,340	3,863	9,215	2,322	3,760	3,941	9,036	58,255
Apr.	5,424	4,643	15,705	3,881	9,079	2,056	5,287	4,087	9,696	59,858
May	5,534	5,331	15,958	4,769	10,347	2,518	5,519	3,675	9,149	64,800
June	5,986	5,716	16,205	5,462	9,117	2,518	4,020	3,932	9,399	62,355
July	4,796	5,330	15,520	4,883	8,093	2,526	3,860	4,381	4,362	53,751
Aug.	6,594	5,547	19,286	6,245	10,530	2,810	6,002	9,194	9,497	75,705
Sept.	6,696	6,971	20,029	6,194	10,340	2,370	7,236	4,308	11,349	75,493
Oct.	7,358	6,975	23,989	7,116	11,555	2,528	8,580	4,859	13,560	86,520

Source: Chemical Division, U. S. Tariff Commission.

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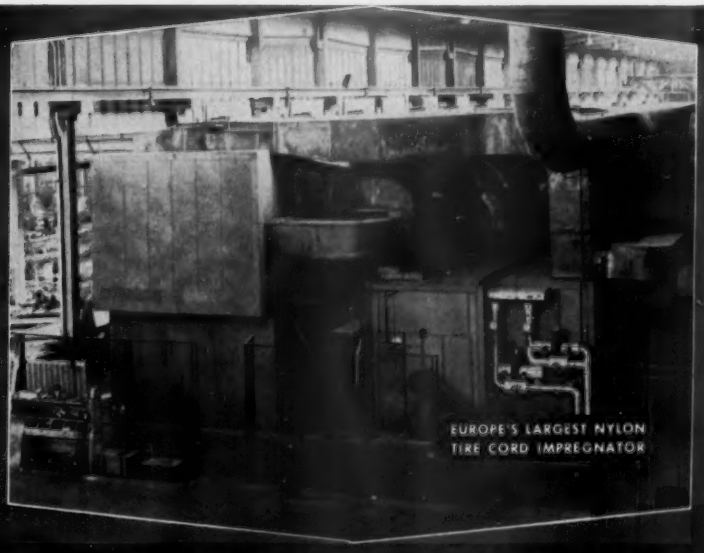

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Rubber Industry Employment Earnings and Hours

All Rubber Products

Mo.	1957 Production Workers (thousands)	1957 Average Weekly Earnings	1957 Average Weekly Hours	1957 Average Hourly Earnings	1958 Production Workers (thousands)	1958 Average Weekly Earnings	1958 Average Weekly Hours	1958 Average Hourly Earnings
Jan.	216.0	$91.21	40.9	$2.23	200.9	$87.48	38.2	$2.29
Feb.	212.6	90.80	40.9	2.22	191.3	85.04	37.3	2.28
Mar.	211.4	89.28	40.4	2.21	184.0	87.02	38.0	2.29
Apr.	191.3	87.60	40.0	2.19	176.0	85.88	37.5	2.29
May	204.2	88.80	40.0	2.22	172.3	87.86	38.2	2.30
June	196.8	91.21	40.9	2.23	175.8	91.10	39.1	2.33
July	199.8	94.16	41.3	2.28	175.1	91.89	39.1	2.35
Aug.	204.3	92.84	40.9	2.27	181.3	96.08	40.2	2.39
Sept.	206.4	92.97	40.6	2.29	188.3	....	...	...
Oct.	209.5	93.03	40.1	2.32	....	....	...	...
Nov.	209.0	93.20	40.0	2.33	....	....	...	...
Dec.	207.3	92.40	40.0	2.31	....	....	...	...

Tires and Tubes

Jan.	87.4	107.64	41.4	2.60	81.6	98.52	36.9	2.67
Feb.	86.8	106.19	41.0	2.59	78.5	93.02	35.1	2.65
Mar.	86.9	102.40	40.0	2.56	76.0	98.05	37.0	2.65
Apr.	71.1	103.46	40.1	2.58	72.1	95.67	36.1	2.65
May	84.9	103.46	40.1	2.58	70.4	99.48	37.4	2.66
June	78.2	107.23	41.4	2.59	71.2	103.63	38.1	2.72
July	83.9	112.20	42.5	2.64	71.0	106.59	38.9	2.74
Aug.	84.2	107.83	41.0	2.63	72.8	112.68	40.1	2.81
Sept.	84.4	107.20	40.3	2.66	....	....	...	...
Oct.	84.4	105.18	39.1	2.69	....	....	...	...
Nov.	84.0	106.62	39.2	2.72	....	....	...	...
Dec.	83.6	105.84	39.2	2.70	....	....	...	...

Rubber Footwear

Jan.	18.3	71.76	39.0	1.84	17.5	74.87	39.2	1.91
Feb.	17.8	72.10	39.4	1.83	17.0	74.68	39.1	1.91
Mar.	17.8	72.68	39.5	1.84	16.7	76.61	39.9	1.92
Apr.	17.5	70.64	38.6	1.83	16.5	75.46	39.3	1.92
May	17.3	71.92	39.3	1.83	16.3	75.85	39.3	1.93
June	17.4	72.29	39.5	1.83	16.3	77.20	40.0	1.93
July	16.8	72.13	39.2	1.84	15.9	75.25	39.4	1.91
Aug.	17.2	73.05	39.7	1.84	16.3	77.78	40.3	1.93
Sept.	17.6	74.45	39.6	1.88	....	....	...	...
Oct.	17.7	76.02	39.8	1.91	....	....	...	...
Nov.	18.0	78.96	40.7	1.94	....	....	...	...
Dec.	17.9	79.35	40.9	1.94	....	....	...	...

All Other Rubber Products

Jan.	110.3	81.39	40.9	1.99	101.8	80.94	39.1	2.07
Feb.	108.0	81.18	41.0	1.98	95.8	80.32	38.8	2.07
Mar.	106.7	81.19	40.8	1.99	91.3	79.87	38.4	2.08
Apr.	102.7	79.60	40.2	1.98	87.4	79.87	38.4	2.08
May	102.0	79.80	40.1	1.99	85.6	80.29	38.6	2.08
June	101.2	81.81	40.7	2.01	88.3	83.77	39.7	2.11
July	99.1	82.62	40.7	2.03	88.2	82.92	39.3	2.11
Aug.	102.9	83.84	41.1	2.04	92.2	86.03	40.2	2.14
Sept.	104.4	85.08	41.1	2.07	....	....	...	...
Oct.	107.4	86.10	41.0	2.10	....	....	...	...
Nov.	107.0	85.05	40.5	2.10	....	....	...	...
Dec.	105.8	84.03	40.4	2.08	....	....	...	...

Source: U. S. Department of Labor.
Note: Data are based upon reports from cooperating establishments covering both full and part-time employees who work during, or received pay for, any part of the pay period ending nearest the 15th of the month. These employment series have been adjusted to first quarter 1954 benchmark levels indicated by data from government social insurance programs. Hours and earnings data pertain only to production and related workers.

Spot Closing Cotton Prices

(Middling Upland Grade—New York Market—in Cents)

Average Monthly Price Per Pound

	1951	1952	1953	1954	1955	1956	1957	1958
Jan.	45.04	42.96	33.24	34.15	35.07	35.24	34.82	36.31
Feb.	(a)	41.64	33.76	35.00	35.04	36.26	34.82	35.83
Mar.	46.06	41.70	34.10	35.23	34.33	36.70	35.35	36.05
Apr.	46.60	41.79	33.85	35.22	34.23	36.81	35.43	36.00
May	46.06	39.98	34.30	35.34	34.80	36.65	35.40	36.27
June	46.06	41.31	34.11	35.17	34.83	36.67	35.45	36.33
July	46.21	40.37	34.20	35.37	34.61	35.43	35.49	36.51
Aug.	35.93	40.42	33.82	35.19	34.53	34.31	35.15	36.36
Sept.	36.20	39.75	33.69	35.46	33.85	34.35	34.74	36.00
Oct.	38.13	37.52	33.53	35.24	33.93	34.45	35.09	36.23
Nov.	42.70	35.59	33.60	34.80	34.87	34.56	36.06	36.24
Dec.	43.32	33.75	33.52	35.03	34.95	34.56	36.50	35.75
Average for Year	42.43	39.71	33.81	35.10	34.59	35.50	35.36	36.16

Note: The Government established a ceiling of 45.76c for spot cotton on March 3, 1951. (a) Trading suspended during February.

Production Index for the Rubber Industry

(1947-1949 = 100)

(Based on man-hours)

	1956	1957	1958		1956	1957	1958
Jan.	147	145	116	July	125	136	125
Feb.	140	141	114	Aug.	135	141	132
Mar.	135	145	116	Sept.	132	138	136
Apr.	136	132	112	Oct.	134	135	135
May	127	134	113	Nov.	126	131	...
June	120	135	125	Dec.	137	117	...

Sales by the Rubber Industry

(in Millions of Dollars*)

	1956	1957	1958		1956	1957	1958
Jan.	415	496	448	July	459	514	478
Feb.	445	495	413	Aug.	436	514	438
Mar.	451	476	396	Sept.	429	481	...
Apr.	445	490	429	Oct.	454	490	...
May	464	481	428	Nov.	463	431	...
June	450	458	445	Dec.	461	427	...

Rubber Manufacturers' Inventories

(in Millions of Dollars*)

	1956	1957	1958		1956	1957	1958
Jan.	935	1,047	1,100	July	987	1,045	980
Feb.	970	1,036	1,087	Aug.	1,007	1,074	1,024
Mar.	979	1,030	1,069	Sept.	1,007	1,074	...
Apr.	970	1,031	1,047	Oct.	1,002	1,097	...
May	985	1,024	1,020	Nov.	1,024	1,101	...
June	975	1,027	986	Dec.	998	1,092	...

Source: U. S. Department of Commerce.
Notes: * Adjusted for seasonal variation.

No. 1 R.S.S.—Annual Average Prices

(New York Market—Cents per Pound)

Year	High	Low	Avg.	Year	High	Low	Avg.
1917	90	52	72.23	1938	17⅞	10¼	14.64
1918	70	40	60.15	1939	24	14⅛	17.57
1919	57	38½	48.70	1940	24	18¼	20.10
1920	56½	16	36.30	1941	24⅞	19½	22.40
1921	21¼	11½	16.36	1942	22½	22½	22.50
1922	28⅜	13⅜	17.50	1943	22½	22½	22.50
1923	37⅛	24¾	29.45	1944	22½	22½	22.50
1924	40⅜	17⅜	26.20	1945	22½	22½	22.50
1925	121	34¾	72.46	1946	22½	22½	22.50
1926	88½	36¾	48.50	1947	25	14	20.00
1927	41¾	33	37.72	1948	25	18	21.99
1928	41¼	17	22.48	1949	19¾	15⅞	17.57
1929	26⅞	15½	20.55	1950	86	18	41.10
1930	16½	7½	11.98	1951	76	52	(a)
1931	8⅝	4¼	6.17	1952*	33	26½	29.15
1932	4¼	2½	3.49	1953	31⅞	19⅞	24.21
1933	9⅞	2⅞	5.96	1954	34½	19½	23.61
1934	15⅞	8¾	12.92	1955	52	29⅜	39.16
1935	13¾	10½	12.37	1956	45	26½	34.24
1936	23	13½	16.41	1957	37⅜	26⅝	31.13
1937	26⅞	14	19.39	1958	32⅝	24⅝	28.13

Note: Price was fixed by Government on August 6, 1941, at 22½c a pound for non-war uses. Free trading was resumed May 1, 1947. (a) Free trading suspended March 31, 1951. GSA selling price ranged between 52 and 66c during balance of year. * Free trading was resumed on July 1, 1952; figures represent only July through December, 1952.

No. 1 R.S.S.—Monthly Average Prices

(New York Market—Cents per pound)

	1951	1952	1953	1954	1955	1956	1957	1958
Jan.	71.21	....	29.40	20.22	33.92	41.70	33.32	27.15
Feb.	73.61	....	27.57	19.98	34.90	33.68	30.43	26.32
Mar.	72.05	....	26.59	20.16	31.08	33.68	31.76	26.64
Apr.	....	....	24.66	22.06	31.75	31.74	32.23	26.44
May	....	....	25.52	21.96	31.35	29.61	32.12	25.51
June	....	....	24.42	23.01	34.74	30.54	32.80	26.20
July	....	30.52	23.64	24.12	40.84	33.91	32.88	27.70
Aug.	....	29.36	23.36	23.26	45.85	35.69	32.13	28.72
Sept.	....	27.42	23.06	23.99	48.27	32.64	29.94	29.49
Oct.	....	27.26	20.82	26.57	43.81	32.68	29.24	31.06
Nov.	....	29.25	20.58	28.07	44.95	35.18	27.47	32.10
Dec.	....	31.26	20.92	29.88	48.40	37.01	29.25	30.28
Average for Year	(a)	29.15	24.21	23.61	39.16	34.24	31.13	28.13

Note: (a) Free trading suspended March 31, 1951, and resumed on July 1, 1952.

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Various Compounding Materials Consumed by the Rubber Industry

Material	1950	1951	1952	1953	1954	1955	1956
Antimony, Primary							
Short tons	103[c]	19[c]	66[c]	20[c]	49[c]	78	56
% of total	.007	.001	.004	.001	.004	006	.013
Asphalt:[a]							
Short tons	26,819	21,414	33,288	.....	.....	.....	.....
% of total	0.3	0.3	0.4	.....	.....	.....	.....
Barite (Barytes):							
Short tons	19,000	15,000	18,000	21,000	20,000	25,104	22,101
% of total	3.31	2.13	2.0	2.0	2.0	2.0	2.0
Carbon Black:							
Short tons	515,184	530,614	537,273	566,797	511,813	643,430	622,325
% of total	92.9	93.9	93.1	94.4	93.5	93.5	95.5
Clay, Kaolin:							
Short tons	263,306	231,331	240,982	241,052	247,431	257,223	268,157
% of total	15.0	12.7	13.2	12.8	13.2	11.9	12.0
Clay, Fire & Stoneware:							
Short tons	9,500	.....	9,322	18,475	8,781	2,928	.....
% of total	0.1	.....	0.1	.2	.1	.2	.....
Lime:							
Short tons	908	1,126	2,000	1,631	1,555	1,465	2,487
% of total	.0002	(d)	(d)	(d)	(d)	(d)	(d)
Litharge:							
Short tons	3,047	2,641	2,109	2,230	1,768	1,947	2,266
% of total	1.7	1.1	1.5	1.4	1.3	1.3	1.7
Lithopone:							
Short tons	4,092	3,295	1,523	1,723	1,701	2,163	2,000[e]
% of total	3.9	3.2	2.5	3.3	3.9	5.0	5.0
Mica, Ground:							
Short tons	5,776	6,551	5,126	5,668	5,021	7,339	7,021
% of total	8.0	9.0	7.0	7.8	6.3	6.9	8.0
Sulfur:							
Short tons	75,000	84,000	84,000	89,600	84,000	89,600	89,600
% of total	1.3	1.4	1.4	1.4	1.3	1.2	1.1
Talc:[b]							
Short tons	75,900	70,970	64,476	61,408	58,139	38,309	30,253
% of total	12.0	11.2	10.9	10.0	9.7	5.4	5.0
Zinc Oxide:							
Short tons	82,944	71,507	72,774	78,439	71,058	86,677	90,000[e]
% of total	51.6	48.4	51.2	52.7	50.7	51.5	52.0

Source: U. S. Bureau of Mines.
Notes: (a) Solid and semi-solid products of less than 200 penetration. (b) Includes prophyllite and ground soapstone. (c) Does not include precipitated antimony sulfide as in previous years. (d) Negligible. (e) Estimated.

Reclaimed Rubber

(Including Natural and Synthetic)

(All Quantities in Long Tons)

Year	New Supply	Consumption: Tons	Consumption: % to Crude[a]	Exports	Stocks On Hand at End of Period
1941	274,202	251,231	32.2	13,851	41,750
1942	286,007[b]	254,820	64.6	30,405	42,532
1943	304,058[c]	291,082	59.6	15,678	46,201
1944	260,631[d]	251,083	35.3	11,800	43,832
1945	243,309	241,036	30.2	13,413	28,155
1946	295,612	275,410	26.5	14,461	33,666
1947	291,395	288,395	24.8	14,556	35,943
1948	266,861	261,113	24.4	11,428	32,630
1949	224,029	226,679	22.5	10,637	28,263
1950	314,008	303,733	24.1	11,740	35,708
1951	366,700	346,121	26.6	14,722	45,082
1952	274,981	280,002	22.2	11,180	30,664
1953	298,336	285,050	21.3	11,597	32,319
1954	258,101	249,049	20.2	10,232	30,746
1955	326,649	312,781	20.4	13,988	31,498
1956	287,220	270,547	18.8	13,832	34,969
1957	271,647	267,352	18.2	13,021	29,323
1957:					
July	20,469	19,676	18.1	757	29,972
Aug.	20,432	22,429	18.1	917	28,521
Sept.	19,892	21,704	17.9	714	25,983
Oct.	26,419	24,925	18.1	1,230	27,171
Nov.	22,083	20,583	17.3	1,150	27,855
Dec.	20,101	18,263	17.2	843	29,323
1958:					
Jan.	21,958	21,186	18.4	892	29,569
Feb.	19,017	18,130	18.0	665	28,838
Mar.	20,225	19,300	18.5	1,012	28,984
Apr.	20,735	19,746	19.1	832	29,440
May	19,601	20,104	19.6	1,012	27,862
June	21,230	20,652	19.2	1,024	27,763
July	18,122	18,350	18.2	1,087	26,442
Aug.	22,432	19,347	17.4	900	27,961
Sept.	22,596	21,771	17.7	1,005	26,676
Oct.	26,523	23,563	17.2	.....	27,340

Source: U. S. Bureau of Mines.
Notes: (a) Solid and semi-solid products of less than 200 penetration. (b) Includes prophyllite and ground soapstone. (c) Does not include precipitated antimony sulfide as in previous years. (d) Negligible. (e) Estimated.

Cotton, Rayon and Nylon Tire Fabrics

(In Thousands of Pounds)

	Production: Rayon Tire Cord Not Woven	Rayon Tire Cord Woven	Cotton and Nylon Cord & Fabric[a]	Chafer Fabrics (all fibers)	Total Tire Cord and Fabric	Stocks[b]: Cotton and Nylon Cord & Fabric	Rayon Cord and Fabric
1957:							
Jan.-Mar.	21,853	68,825	31,393	11,028	123,182	11,844	37,153
Apr.-June	16,037	63,195	35,308	10,456	115,418	13,428	13,473
July-Sept.	10,509	54,968	33,477	9,147	100,091	13,305	36,388
Oct.-Dec.	9,216	58,392	32,827	10,176	101,687	14,909	29,632
Total	57,615	245,380	133,005	40,807	440,378	53,486	116,646
1958:							
Jan.-Mar.	8,372	56,522	25,647	7,367	92,924	11,255	33,913
Apr.-June	.....	.....	30,745	6,020	80,533	11,274	26,327
July-Sept.	.....	.....	31,371	6,467	91,984	11,229	26,428
Oct.-Dec.	.....	.....	.....	.....	.....	.....	.....
Total	.....	.....	.....	.....	.....	.....	.....

Source: Bureau of the Census, U. S. Department of Commerce.
Notes: (a) Combined to avoid disclosing figures for individual companies. (b) At end of period.

Gasoline Consumption

(In Thousands of Barrels of 42 Gallons)

	1952	1953	1954	1955	1956	1957	1958
Jan.	86,863	89,634	89,852	96,397	100,642	109,295	107,281
Feb.	82,043	86,458	86,206	88,464	98,088	96,694	95,516
Mar.	87,065	98,158	101,549	105,684	112,412	113,166	108,914
Apr.	98,563	102,044	103,866	111,116	113,034	115,820	118,477
May	101,137	105,918	104,418	115,707	123,560	124,325	125,137
June	99,305	114,703	113,037	120,710	126,838	121,598	125,444
July	105,307	112,969	112,231	115,653	120,708	130,251	130,903
Aug.	102,954	109,124	110,223	121,816	125,847	128,808	129,925
Sept.	100,095	106,158	104,706	113,379	111,574	113,567	27,437
Oct.	103,689	106,037	105,607	112,558	119,204	119,334	.....
Nov.	91,326	99,210	102,393	109,212	112,113	107,705	.....
Dec.	95,817	100,225	104,258	111,034	108,096	112,691	.....
Total	1,154,254	1,230,629	1,238,346	1,321,730	1,372,116	1,393,254	.....

Source: U. S. Bureau of Mines.

U. S. Gross Imports of Balata, Jelutong, Gutta-Percha, etc.

(All Quantities in Long Tons)

Year	Balata: Tons	Balata: Value	Jelutong: Tons	Jelutong: Value	Gutta-Percha & Other Guttas: Tons	Gutta-Percha & Other Guttas: Value
1945	1,361	907.253	....	.....	36	21.970
1946	2,281	2,233.065	304	256.169	423	458.064
1947	1,982	2,276.531	2.878	1.496.887	392	779.591
1948	1,195	805.078	3.401	2,377.765	423	542.788
1949	1,391	814.354	1.043	834.978	197	189.021
1950	2,117	1,589.885	1.789	1.515.162	541	745.418
1951	2,452	1,973.271	1.669	2.608.359	383	430.539
1952	988	762.994	1.636	2.094.983	282	385.890
1953	1,619	866,248	1.027	1.166.837	235	303.116
1954	949	504.065	2,196	2,624.926	417	511.055
1955	1,022	967.369	1.679	1.731.821	284	318.115
1956	1,396	1,111.165	1.851	1.909.447	290	309.615
1957	1,037	670,821	1,680	1,942,067	230	270,487
1957:						
Dec.	71	55.902	136	144,229	....	.....
1958:						
Jan.	10	9,732	122	132,581	6	12,975
Feb.	4	3,390	46	45,507	7	19,454
Mar.	33	21,631	98	98,250	8	13,126
Apr.	6	2,787	74	75,302	17	19,187
May	242	131,642	131	151,130	22	35,366
June	16	11,515	89	108,419	21	28,739
July	19	12,359	201	254,075	42	45,692
Aug.	53	36,666	135	149,918	10	16,675

Source: U. S. Department of Commerce.

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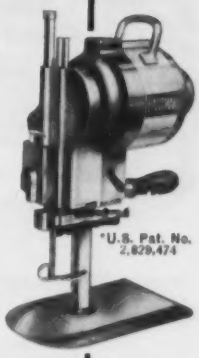

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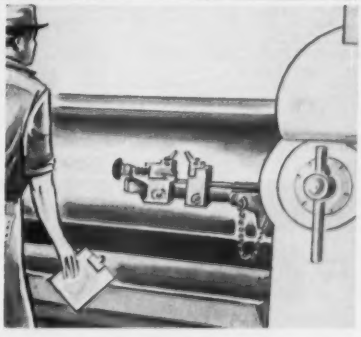

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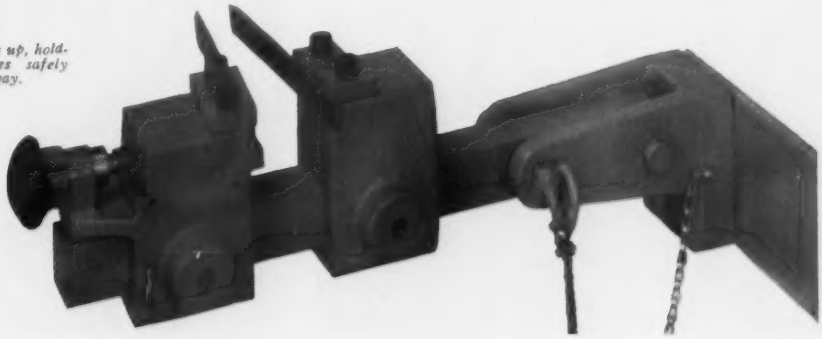

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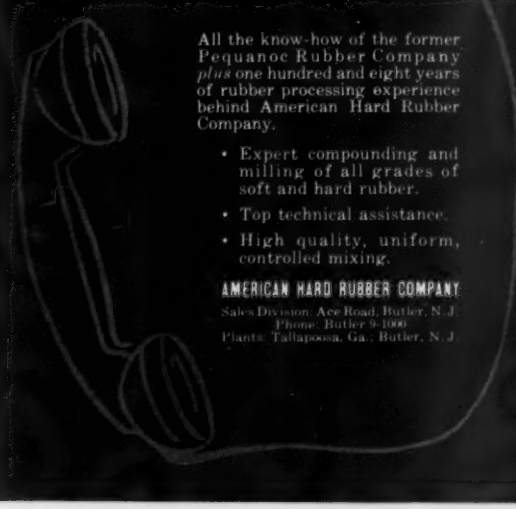

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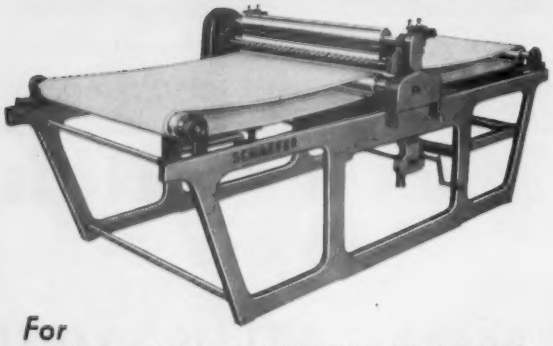

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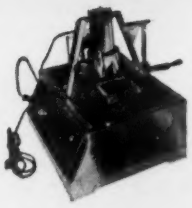

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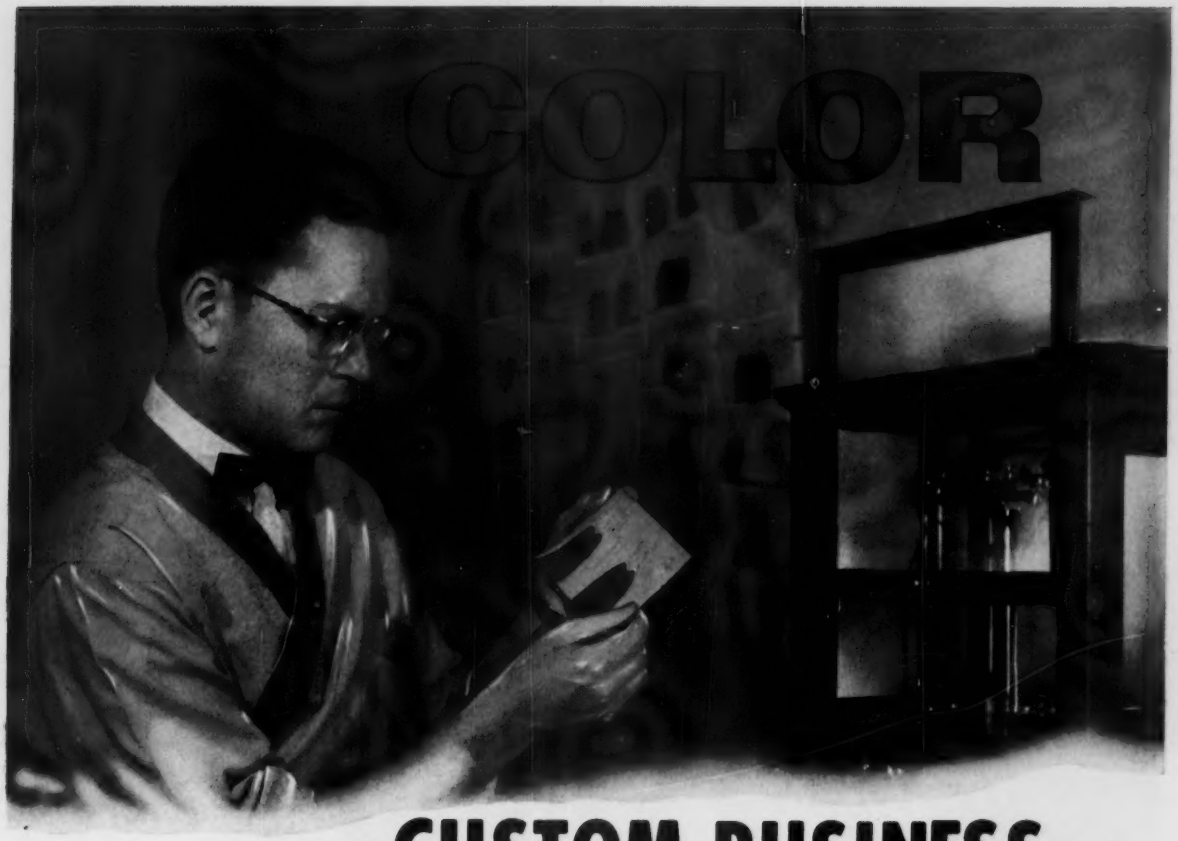

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